

**MASTER
GUARD**

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Series S_{III}
from 60 to 800 kVA



Uninterruptible Power Supply Systems

UPS Catalogue • 2005

Series S_{III} from 60 to 800 kVA

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1 Scope

This specification describes a continuous duty three-phase, solid state, insulated gate bipolar transistor (IGBT) uninterruptible power supply (UPS) system. The UPS shall automatically provide continuity of electrical power, within defined limits

and without interruption, upon failure or degradation of the commercial AC source. The continuity of conditioned electric power shall be delivered for the time period defined by the battery system. The inverter, and other mission critical converters within the

UPS, are driven by vector control algorithms (covered by patents 95 P3875, 95 P3879 and 96 P3198) running on dedicated digital signal processor (DSP) systems.

2 System description

This specification describes a static UPS in intelligent double conversion configuration, as shown in Figure 1. The systems shall operate on a microprocessor-based IGBT inverter. The vector control technology will enhance the performance of the inverter. In order to increase system redundancy, an independent electronic static bypass shall be integrated into the UPS. By adding system components, such as parallel kits, central output cubicles, CROSS switches, safety and disconnecting devices, system bypass switches, in addition to software and communications solutions, it shall be possible to set up elaborate systems

to ensure the complete protection of the loads.

2.1 The system

The UPS shall provide high quality AC power for electronic equipment loads and shall offer the following features:

- Increased power quality
- Full noise rejection
- Full compatibility with all types of loads
- Power blackout protection
- Full battery care

The UPS shall automatically provide continuity of electrical power, within defined limits and without interruption, upon failure or degradation of the commercial AC source. The duration of autonomy (i.e. back up power time) in the event of network failure shall be determined by the battery capacity.

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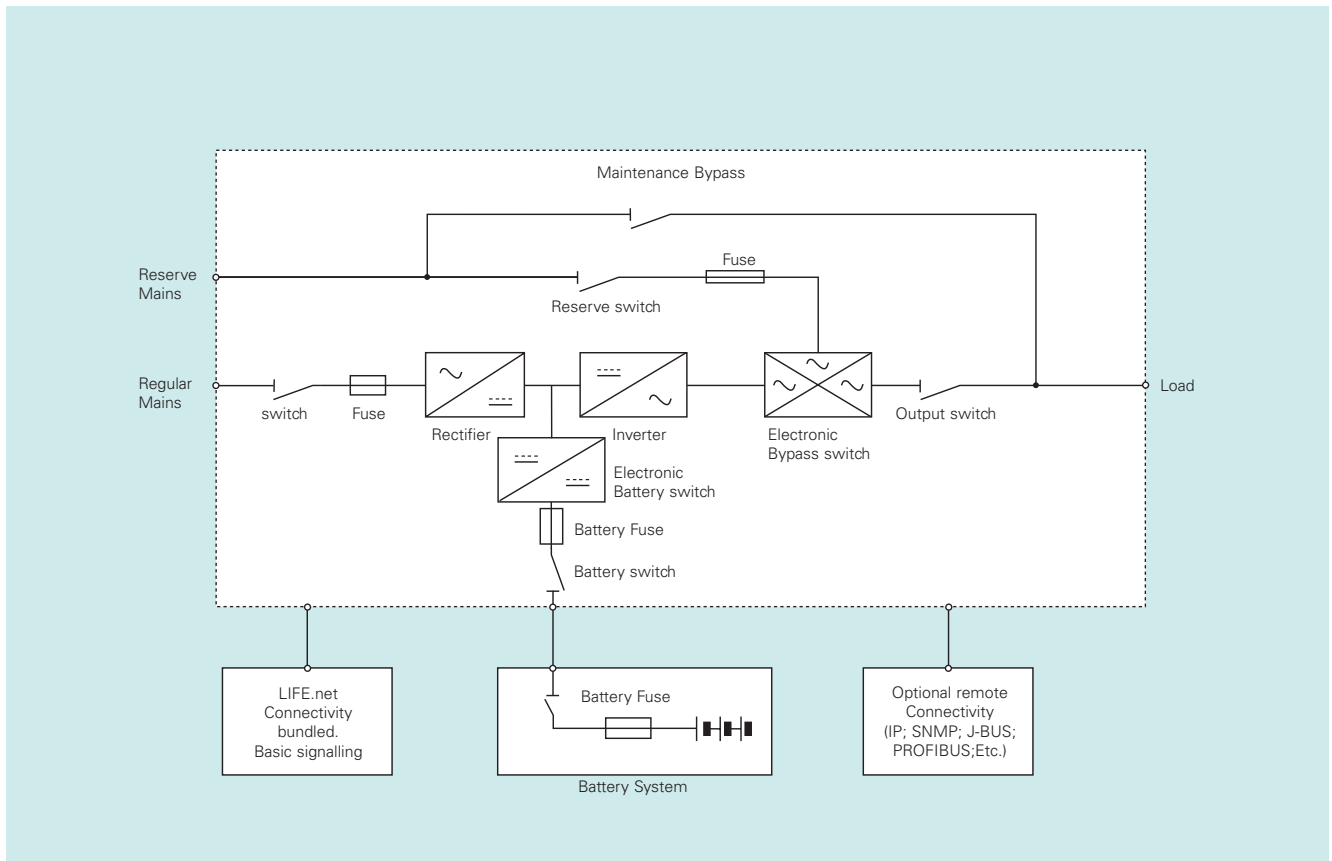


Figure 1. Series S_{III} single block system

MASTERGUARD Series S_{III} UPS Systems from 60 to 800 kVA

2 System description

2.2 Models Available

The Series S_{III} range shall include the following three-phase input/output models:

MODEL	Rating (kVA)	MODEL	Rating (kVA)
Series S _{III} /60	60	Series S _{III} /250	250
Series S _{III} /80	80	Series S _{III} /300	300
Series S _{III} /100	100	Series S _{III} /400	400
Series S _{III} /120	120	Series S _{III} /500	500
Series S _{III} /160	160	Series S _{III} /600	600
Series S _{III} /200	200	Series S _{III} /800	800

3 Device description

Series S_{III} is the result of an innovative research and development programme designed to offer users the most reliable power supply at a minimum cost.

3.1 Components

The UPS shall consist of the following major components:

- Rectifier/battery charger/electronic battery switch
- IGBT inverter
- Digital signal processor (DSP)
- Electronic static switch and reserve supply
- Manual maintenance bypass switch
- Matching battery cubicles

3.2 Microprocessor control and diagnostics

Operation and control of the UPS shall be provided through the use of microprocessor-controlled logic. Indications, measurements and alarms, together with battery autonomy, shall be shown on an illuminated, forty character liquid crystal display (LCD). The procedures for start up, shutdown and manual transfer of the load to and from bypass shall be explained in clear step-by-step sequences on the LCD display.

3.3 Intelligent double conversion operating modes

Series S_{III} shall adopt intelligent double conversion technology which allows the UPS to operate in double conversion or digital interactive mode according to the selected priority. The UPS will operate as follows:

3.3.1 Double Conversion Mode

3.3.1.1 Normal

The UPS inverter continuously supplies the critical AC load. The rectifier/charger derives power from the commercial AC source and converts it into DC power for the inverter whilst simultaneously maintaining the battery in a fully charged and optimum operational condition (for more details see section 5.11 "Battery Management"). The inverter converts the DC power into clean and regulated AC power which is supplied to the critical load through the static transfer switch. The static switch monitors and ensures that the inverter tracks the reserve supply frequency. This ensures that any automatic transfer to the reserve supply (due to an overload etc.) is frequency synchronised and does not cause interruption to the critical load.

3.3.1.2 Overload

In the event of an inverter overload, manual stop or failure the static switch shall automatically transfer the critical load to the reserve supply without interruption.

3.3.1.3 Emergency

Upon failure or reduction of the commercial AC source (see tables 11 and 12 for tolerances), without switching, the inverter shall supply the critical load, drawing power from the associated battery. There shall be no interruption to the critical load upon failure, reduction or restoration of the commercial AC source. While the UPS is powered by the batteries, indications shall be provided of actual autonomy time remaining as well the duration of the mains failure.

3.3.1.4 Recharge

Upon restoration of the commercial AC source, even where batteries are completely discharged, the rectifier/charger shall restart automatically, 'walk in' and gradually take over both the inverter and battery recharge loads. This function shall be fully automatic and shall cause no interruption to the critical load.

3.3.2 Digital interactive mode

If priority has been set to digital interactive mode, intelligent double conversion technology shall allow Series S_{III} to continuously monitor the condition of the input supply including its failure rate to ensure maximum reliability for critical users. On the basis of the analysis performed, it shall decide whether to supply the load through the direct line or the conditioned line.

This operational mode, which allows significant energy savings by increasing the overall AC/AC efficiency of the UPS (see section 11.6), is primarily intended for general purpose ICT applications. However, it does not provide the same output power quality as when the UPS operates in double conversion mode. Therefore it will be necessary to verify whether this mode is appropriate for special applications. Digital interactive mode is not available for parallel systems.

3.3.2.1 Normal

The operating mode will depend on the quality of the mains supply in the short-term past. If the line quality has remained within permitted tolerance parameters in this timeframe, the direct line will provide continuous supply to the critical AC load through the static switch. The IGBT inverter will remain in constant operation and synchronisation with the direct line.

3 Device description

This ensures that the load can be transferred to the conditioned line without break in supply where there is a deviation from the selected input power tolerance levels. If the direct line failure rate has been outside permitted parameters, Series S_{III} shall supply the load from the conditioned line. The battery charger supplies the energy necessary for maintaining maximum charge to the battery.

3.3.2.2 Inverter stop or overload

If the inverter is stopped either by the operator or as a result of an overload, there is no transfer to the conditioned line and the load continues to be supplied by the direct line. The mains voltage and frequency values must be within the tolerance limits specified. In the event of an overload with a duration in excess of the maximum capacity specified, the load is transferred to the conditioned line, which will supply it for a specific time depending on the level of overload. In the event of an overload and an unsuitable mains supply, Series S_{III} shall transfer the load from the direct line to the conditioned line (assuming Series S_{III} was operating from the direct line) and the inverter shall continue to supply the critical load for a period dependant on the degree of the overload and the UPS features. Visual and audio alarms alert the user to the problem.

3.3.2.3 Emergency (due to mains supply failure or variance beyond tolerance limits)

If Series S_{III} is supplying the load via the direct line and the mains supply varies beyond tolerance levels (adjustable using the software from $\pm 2\%$ to $+10\%$ -8%), the load will be transferred from the direct line to the conditioned line. The load is powered from the mains via the rectifier and inverter, (provided the input mains remains within the tolerances stated in tables 11 and 12). Should the input mains falls below the lower limit the batteries shall be used to power the load via the inverter. The user is alerted to the battery discharge by visual and audio alarms and the remaining autonomy is displayed on the LCD. During this process, it is possible to extend the remaining autonomy by switching off non-essential loads.

3.3.2.4 Return to normal conditions

When the mains supply returns to within tolerance limits, Series S_{III} will continue to supply the load via the conditioned line for a period of time dependant on the direct line failure rate (the conditioned line draws power from the mains not the battery). When the direct line has stabilised, Series S_{III} returns to normal operation. The battery charger automatically begins to recharge the battery, so that maximum autonomy is guaranteed in the shortest possible time.

3.3.3 Maintenance bypass

If for any reason it is necessary to take the UPS out of service for maintenance or repair, the UPS shall be fitted with an internal maintenance bypass switch which enables a load transfer to a reserve supply with no interruption to power to the critical load. Bypass isolation shall be complete, all serviceable components such as fuses, power modules etc. shall be isolated. Transfer/retransfer of the critical load may be accomplished by automatic synchronisation of the UPS to the reserve supply and paralleling the inverter with the reserve source, before opening or closing the bypass switch as appropriate.

3.3.4 Operation Without Battery

If the battery is taken out of service for maintenance, it is to be disconnected from the rectifier/charger by means of a switch situated in the UPS cabinet. The UPS will continue to operate and meet the performance criteria specified with the exception of the stand-by period. In such a case, the overload performance from the conditioned line may also be affected, depending on the actual input voltage level.

3.4 Control and diagnostics

Control of the power electronics modules shall be optimised in order to provide:

- optimum three-phase supply of the load
- controlled battery charging
- minimum phase effects upon the supply network.

By using digital signal processors (DSP) Series S_{III} shall implement the most advanced digital control.

3.4.1 Vector control

To ensure the quick and flexible processing of measuring data, special arithmetic algorithms shall be implemented in DSP, rapidly generating controlled variables as a result. This will thus render possible the real-time control of the inverter electronics, resulting in obvious advantages concerning the performance of the power components. These advantages will be:

- Improvement of short circuit behaviour, as individual phases can be more quickly controlled
- Synchronism or phase angle precision between UPS output and reserve supply even in the case of a distorted mains voltage.
- High flexibility in parallel operation: parallel blocks may be housed in separate rooms.

Several algorithms included in the Vector Control firmware are covered by patents owned by MASTERGUARD (95 P3875, 95 P3879 and 96 P3198).

3.4.2 Redundancy, preventive monitoring

In order to maximise the reliability of the system, the control unit shall monitor a wide number of operating parameters for the rectifier, inverter and battery. All vital operating parameters, such as temperatures, frequency and voltage stability at the system output, load parameters and internal system values shall be constantly monitored and controlled for irregularities at all times. The system shall react automatically before a critical situation arises either for the UPS or the load, in order to ensure the supply of the load even in these difficult conditions.

3.4.3 Telediagnosis and telemonitoring

In all the above modes of operation, the UPS may be monitored and controlled from a remote location such as a service centre, in order to maintain the reliability of the system at nominal levels. Even during complete shutdown of the UPS, information relating to the operating parameters shall not be lost thanks to non volatile RAMs, which will store the information for up to 10 years.

4 General Requirements

4.1 Applied standards

MASTERGUARD operates in accordance with TUEV Cert procedures a Quality Management System which complies with EN ISO 9001:2000 for the design, manufacture, sales, installation, maintenance and service of uninterruptible power supply systems. The MASTERGUARD Environmental Policy and Management Systems comply with EN ISO 14 001 and MASTERGUARD is committed to implementing a policy of continuous improvement to production processes and pollution reduction. Series S_{III} shall carry the CE mark in accordance with the Safety and EMC Directives 73/23, 93/68, 89/336, 92/31 and 93/68. Series S_{III} is designed and manufactured in accordance with the following international standards:

- EN50091-1 general and safety requirements
- EN50091-2 EMC requirements
- IEC EN62040-3 operating requirements.

4.2 Safety

In terms of general and safety requirements, the UPS conforms to standard EN50091-1-2 governing use in restricted access locations.

4.3 EMC and surge suppression

Electromagnetic effects shall be minimised in order to ensure that computer systems and other similar electronic loads shall neither be adversely affected by nor affect the UPS. The UPS shall be designed to meet the requirements of EN 50091-2. The manufacturer and customer in partnership agree to ensure the essential EMC protection requirements for the specific resulting installation.

4.4 Neutral connection and grounding

The Series S_{III} output neutral shall be electrically isolated, except for RFI filters, from the UPS chassis. The input and output neutral connections are the same, i.e. they are solidly tied together. Therefore the UPS shall not modify the state of the upstream

neutral, in any operating mode, and the neutral state of the distribution downstream from the UPS is imposed by the mains one. Series S_{III} should be used in installations with grounded neutral; for further details please contact MASTERGUARD Technical Support.

4.5 Materials

All materials and components comprising the UPS shall be new and of current manufacture.

5 AC/DC Converter

5.1 General/Input

The three-phase current taken from the commercial AC source shall be converted to a regulated DC voltage by a rectifier available in both 6-pulse and 12-pulse versions. Above 200kVA Series S_{III} will be available with a 12 pulse rectifier (consisting of two 6-pulse thyristor rectifiers operating at a phase shift of 30°) and harmonic filters as standard. In order to protect the power components within the system each phase of the rectifier input shall be individually fitted with a fast-acting fuse.

The rectifier battery charger shall be operable with the following types of batteries:

- Sealed Lead Acid
- Lead Acid
- NiCd

The selection of the optimum charging method shall be completely managed by the microprocessor.

5.2 Voltage regulation, temperature compensation

The rectifier output voltage shall operate within narrow parameters. In order to ensure optimum battery charging regulation shall be automatically adjusted to the ambient temperature.

The rectifier shall be capable of supplying the inverter with DC voltage at rated power, even if the input voltage is below the nominal voltage tolerance specified. This will not require the discharging of the batteries. This connection is illustrated in Figure 2.

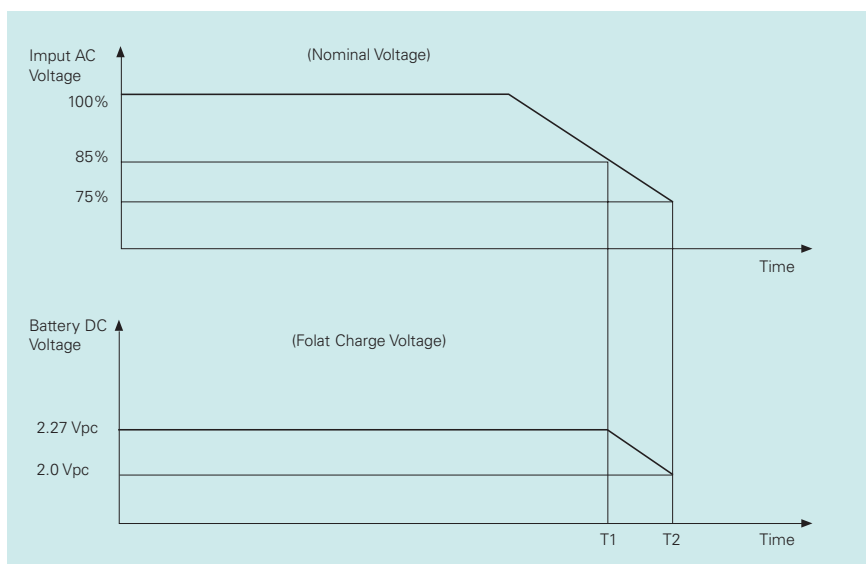


Figure 2. Rectifier behaviour during reduction of the commercial AC source.

5 AC/DC Converter

5.3 Soft start

After applying the input voltage the rectifier starts a programmable current soft start (1-90 seconds). This procedure results in a gradual and soft walk-in of the current taken from the input voltage supply network. This ensures that any standby generator is gradually introduced into the UPS input, as shown in Figure 5. To avoid the simultaneous start-up of different rectifiers, it is possible to programme a hold-off dedicated start delay (1-180 seconds) for each unit. In addition, the UPS includes an 'on generator' function which, when activated via floating contact, provides the possibility, of inhibiting either battery charging, synchronisation of the inverter to the direct line supply or transfer to the direct line.

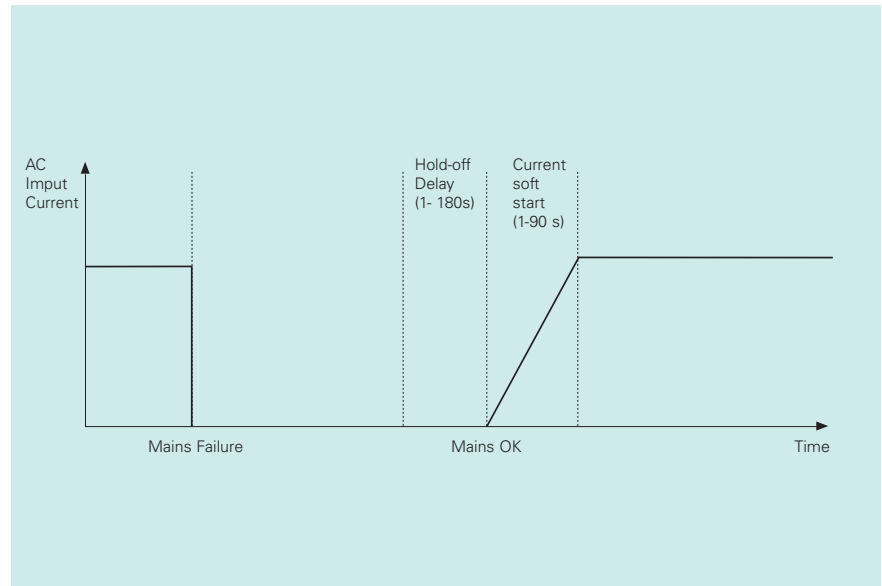


Figure 3. Rectifier soft start

5.4 Power factor (available only for 60-500kVA range)

The rectifier/battery charger control provides an algorithm for input power factor optimisation.

When batteries are fully charged, the battery care algorithm puts them on stand-by (see section 5.11 "Battery Management"). It is in this condition that the rectifier enters its PFC mode (Power-Factor Control). In this mode it is able to perform a dynamic real-time maximisation of the input power factor, compensating mains utility fluctuations. The PFC makes it possible to reach $PF > 0.92$ (>0.9 for twelve-phase configurations) under normal operating conditions. This means time-average $PF > 0.9$ for most typical applications.

Example: assuming a typical utility MTBF of 200h and a 10h period for full battery recharge results shall be:

$$\begin{aligned} PF &= 0.75 && 10 \text{ hours} \\ PF &= 0.92 && 190 \text{ hours} \\ PF_{AVG} &= (0.75 \cdot 10 + 0.92 \cdot 190) / 200 = 0.91 && 200 \text{ hours} \end{aligned}$$

5.5 Residual ripple filtering

The rectifier output shall have a residual voltage ripple of $< 2\%$ RMS, with batteries disconnected.

5.6 Total harmonic distortion (THD) of input voltage

The maximum voltage THD permitted on the rectifier input (either from the

utility or generator) shall be 15% (normal operation is guaranteed up to 8%). The maximum current THD injected into the mains shall be 30% but will be reduced to 5% for the units above 200 kVA which shall have 12 pulse rectifiers and filters provided as standard.

5.7 Operation with diesel generator

In order to obtain the required THD on input voltage, the coordination between diesel generator and UPS shall be based on the generator's sub-transient reactance, as opposed to its short-circuit reactance.

5.8 Capacity and charging characteristics

The rectifier shall be capable of supporting the inverter at nominal power and supplying the batteries with charging current. After discharge of the battery the rectifier will power the inverter and recharge the batteries. The following charging methods for the different types of accumulators are available:

5.8.1 Sealed, maintenance-free lead acid accumulators:

Charging at constant current up to the maximum load voltage level. Thereafter the loading voltage shall be kept at a constant level within narrow limits (single-step charging method).

5.8.2 Sealed, low-maintenance lead acid accumulators or NiCd accumulators:

Charging at increased charging voltage and constant charging current. If the charging current falls short of a lower threshold value the rectifier shall automatically return to load voltage level (two-step charging method).

5.9 Overvoltage protection

The rectifier/battery charger shall automatically switch off if the DC voltage exceeds the maximum value associated with its operational status.

5.10 Shared battery operation

UPS in parallel configuration can operate with common batteries (a maximum of two UPS can share a common battery bank). In this case the batteries are recharged in parallel by the rectifiers of the two UPS. The total current supplied by the rectifiers is divided equally, with a maximum unbalance equal to the programmed level of battery current limits.

Although this configuration leads to optimisation of the initial economic investment, it reduces reliability advantages, which are usually offered by parallel UPS systems (see chapter 14 for details).

5 AC/DC Converter

5.11 Battery Management

Using advanced battery care (ABC) Series S_{III} series shall increase battery life by up to 50%. The main battery care features are described below.

5.11.1 Operating Parameters

When operating with a maintenance free, valve regulated lead acid battery (VRLA), the parameters per cell shall be as follows:

- End of discharge voltage (V) 1.65
- Shutdown imminent alarm (V) 1.75
- Minimum battery test voltage (V) 1.9
- Nominal voltage (V) 2.0
- Battery discharging alarm (V) 2.20 @ 20°C
- Float voltage (V) 2.27 @ 20°C
- High voltage alarm (V) 2.4

5.11.2 Automatic Battery Test

The operating condition of the batteries shall be automatically tested by the control unit at selectable intervals, e.g. weekly, fortnightly or monthly. A short-time discharge of the battery will be made to confirm that all the battery blocks and connecting elements are in good working order. In order to preclude a faulty diagnosis the test will be launched 24 hours after the latest battery discharge at the earliest. The battery test shall be performed without any risk to the user, even if the battery is completely defective. Users shall be alerted to a detected battery fault. The battery test shall not cause any degradation in terms of the battery system life expectancy.

5.11.3 Ambient Temperature Compensated Battery Charger

The float voltage and battery discharge alarm shall be automatically adjusted as a function of the temperature in the battery compartment (-0.11% per °C) in order to maximise battery operating life.

5.11.4 Time Compensated End Of Discharge Voltage

When the discharge time exceeds one hour, the shutdown voltage shall be automatically increased, as shown in Figure 4 for VRLA, to avoid heavy battery discharge as a result of a light load.

5.11.5 Battery Ripple Current (only for 60-500kVA range)

When batteries are fully charged the battery care algorithm places them in stand-by mode, disconnecting them from the rectifier. This status prevents charging current ripple and enhance battery operating life.

5.11.6 Remaining Battery Life

Series S_{III} uses sophisticated algorithms to determine the battery life remaining based on real operating conditions such as temperature, discharge and charging cycles, and discharge depth.

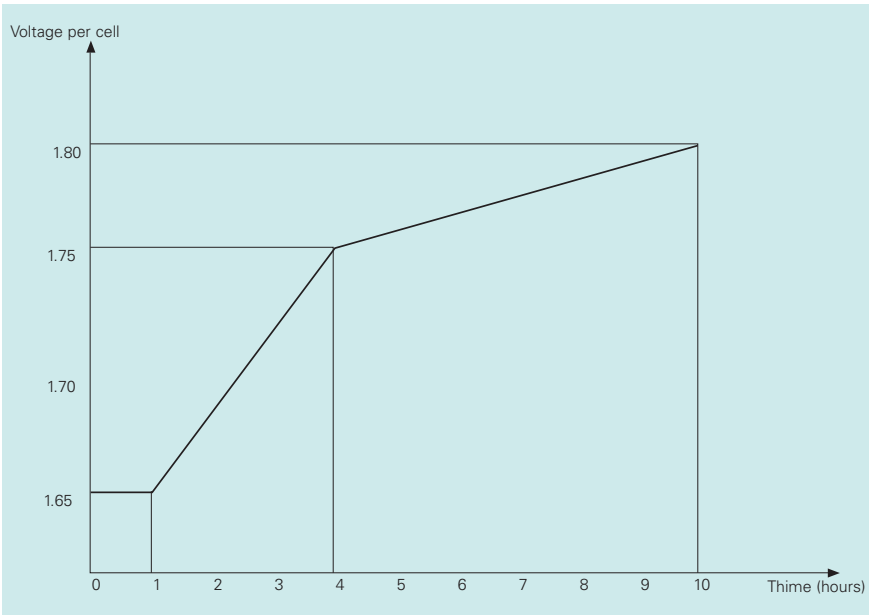


Figure 4. End-of-discharge voltage in relation to discharge time

6 Control Unit, IGBT Inverter

6.1 AC voltage generation

From the DC voltage of the intermediate circuit the inverter shall generate sinusoidal AC voltage for the user load on the basis of pulse-width modulation. By means of the digital signal processor of the control unit the inverter IGBTs shall be controlled so that DC voltage is divided up into pulsed voltage packets. A transformer shall be provided at the output of the inverter. Through this transformer and a low-pass filter the pulse-width modulated signal shall be converted into sinusoidal AC voltage.

6.2 Voltage regulation

The inverter output voltage on the three phases shall be individually controlled to achieve the following performances:

6.2.1 Steady state

The inverter steady state output voltage shall not deviate by more than $\pm 1\%$ in a steady state condition for input voltage and load variations within the quoted limits.

6.2.2 Voltage transient response

The inverter transient voltage shall not exceed Class 1 limits when subjected to application or removal of 100% load as defined by EN62040-3.

6.3 Frequency regulation

The inverter output frequency shall be controlled to achieve the following performances:

6.3.1 Steady state

The inverter steady-state output frequency, when synchronised to reserve supply, shall not deviate by more than $\pm 0.75\%$ adjustable to $\pm 1.5\%$, $\pm 2.5\%$, $\pm 6\%$.

6.3.2 Frequency slew rate

The frequency slew rate shall be $\leq 1\text{Hz}$ per second.

6.3.3 Frequency Control

The output frequency of the inverter shall be controlled by a quartz oscillator which can be operated as a free running unit or as a slave for synchronised operation with a separate AC source. The accuracy of the frequency control shall be $\pm 0.05\%$ when free-running.

6.4 Total Harmonic Distortion

The inverter shall provide harmonic neutralisation and filtering to limit the THD to on the voltage to less than 3% with a linear load. For reference non-linear load (as defined by EN62040-3) the THD shall be limited to less than 5%.

6.5 Neutral sizing

The sizing of the inverter neutral shall be oversized on all ratings in order to cope with the combination of harmonics on the neutral wire when driving single-phase reference non-linear loads. From 60 to 200kVA the inverter neutral is sized x 1.7 in relation to the phase, while from 250 to 500kVA it is x 1.4 in relation to the phase. Further oversizing could be provided on demand.

6.6 Output power transformer

A dry type isolation transformer shall be provided for the inverter AC output. The transformer shall have an insulation class H+. The temperature limit of the insulation class of the material shall not be exceeded when operating at full load and within ambient temperature limits.

6.7 Overload

The inverter shall be capable of supplying an overload of 125% for 10 minutes and 150% for one minute of the nominal power.

6.8 Inverter shutdown

In the event of an internal failure the inverter shall be immediately disconnected from the critical load and shut down by the control unit. The UPS device or the parallel-operated UPS systems shall continue to supply the

load from the reserve supply without interruption, if it is within permissible limits.

6.9 Output voltage symmetry

The inverter shall guarantee the symmetry of the output voltages at $\pm 1\%$ for balanced loads and $\pm 3\%$ for 100% unbalanced loads.

6.10 Phase displacement

The phase angle displacement between the three-phase voltages shall be:

- $120^\circ \pm 1^\circ$ for balanced loads
- $120^\circ \pm 2^\circ$ for unbalanced loads (0, 0, 100%)

6.11 Short Circuit

The inverter short circuit capacity of Series S_{III} for the first 10ms shall be $>200\%$ for any short circuit configuration. After the first 10ms, it shall limit the current to $>150\%$ for 5s, then it shall shut down.

6.12 Automatic upgrade of inverter rated power

The inverter shall automatically upgrade its power as a function of ambient and operating temperatures, as shown in Figure 5. In the most common conditions (25°C) Series S_{III} shall provide 10% more power than nominal. In these conditions the battery charge will be reduced correspondingly.

For example:

@40°C, $I_{dc\ tot.} = 0.75(I_{dc\ inv}) + 0.25(I_{batt})$

@25°C, $I_{dc\ tot.} = 0.83(I_{dc\ inv}) + 0.17(I_{batt})$

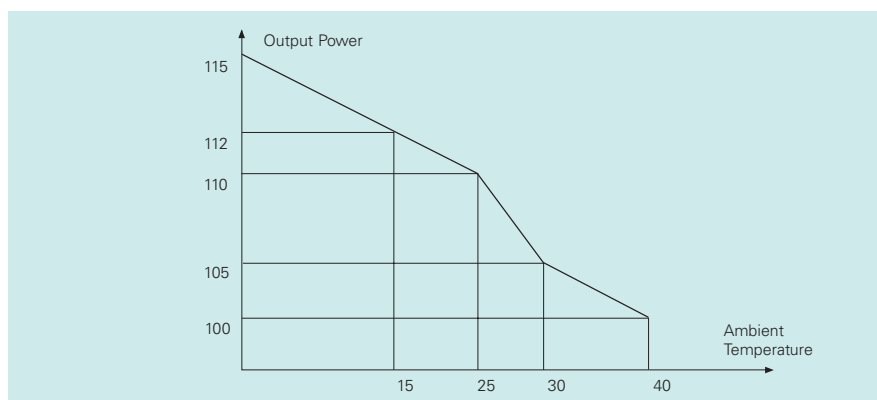


Figure 5. Automatic power upgrade

7 Electronic Static Switch

7.1 General

The electronic static switch shall be a fully rated, high speed, solid-state transfer device and rated for continuous duty operation. Each AC phase of the input shall be individually fitted with fast acting fuses to prevent cascading failures.

The following transfer and retransfer operations shall be provided by the electronic static switch:

- Uninterrupted automatic transfer to the reserve supply in the event of:
 - inverter output overload
 - DC voltage outside limits
 - over-temperature
 - inverter failure
- If inverter and reserve supply are not synchronised at the time of a necessary transfer, a switching delay can be set to protect the critical load. This prevents possible damage to the load by unintentional phase shift. A delay of 20ms will be preset as a standard value.
- Uninterrupted manual transfer/retransfer to and from the reserve supply shall be initiated from the control panel.
- Uninterrupted automatic transfer/retransfer to and from the reserve supply by activation of the line interactive mode.

- Uninterrupted automatic retransfer from the reserve supply, as soon as the inverter regains the capacity to supply the load.
- The uninterrupted transfer from the inverter to the reserve supply shall be inhibited in the following situations:
 - reserve supply voltage outside limits
 - failure of electronic bypass switch.
- The uninterrupted automatic retransfer may be inhibited in the following situations:
 - manual switching to reserve supply via the maintenance switch
 - failure in output switch behind inverter
 - UPS output overload.

7.1.1 Voltage

The nominal voltage of the reserve line shall be 230/400V_{RMS}. Any transfer from inverter to reserve line will be inhibited if the voltage is beyond a limit of ±10% (standard setting) of the nominal voltage.

7.1.2 Transfer time (double conversion)

The switching time for a transfer from the inverter to the reserve supply or vice versa shall be less than 0.5ms when synchronised. The system shall ensure that the inverter is stable and operating normally before permitting a retransfer of the load back to inverter.

This automatic retransfer delay time back to inverter from reserve shall be 5 seconds. The transfer time when out of synchronisation shall be 20 milliseconds to prevent damage to the load by phase reversal.

7.1.3 Overload

The electronic static switch shall be capable of supporting the following overloads:

125%	for	10 minutes
150%	for	1 minute
700%	for	600 milliseconds
1000%	for	100 milliseconds

7.1.4 Manual maintenance bypass

It shall be possible to implement a manual uninterrupted bypass of the complete system in order to enable maintenance work to be carried out on the system. The reserve supply will continue to feed the load. In this case the UPS will be voltage-free as it will be disconnected from the supply networks. In this case, maintenance work on the UPS can be carried out without affecting the connected electric load.

8 Monitoring and control, Interfaces

8.1 General

The UPS shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, and take action where appropriate. Furthermore, interfaces allowing extended monitoring and control, in addition to service functions shall be available. UPS rated from 60kVA up to 500kVA feature a mimic panel with graphical LCD display as described in the section below, while UPS rated 600kVA and 800kVA feature a specific LCD and LED mixed mimic panel (for further details refer to the User Manuals pertaining to these models).

8.2 Mimic panel (60 to 500kVA)

The control panel of Series S_{III} includes a back-lit Liquid Crystal Display (LCD of

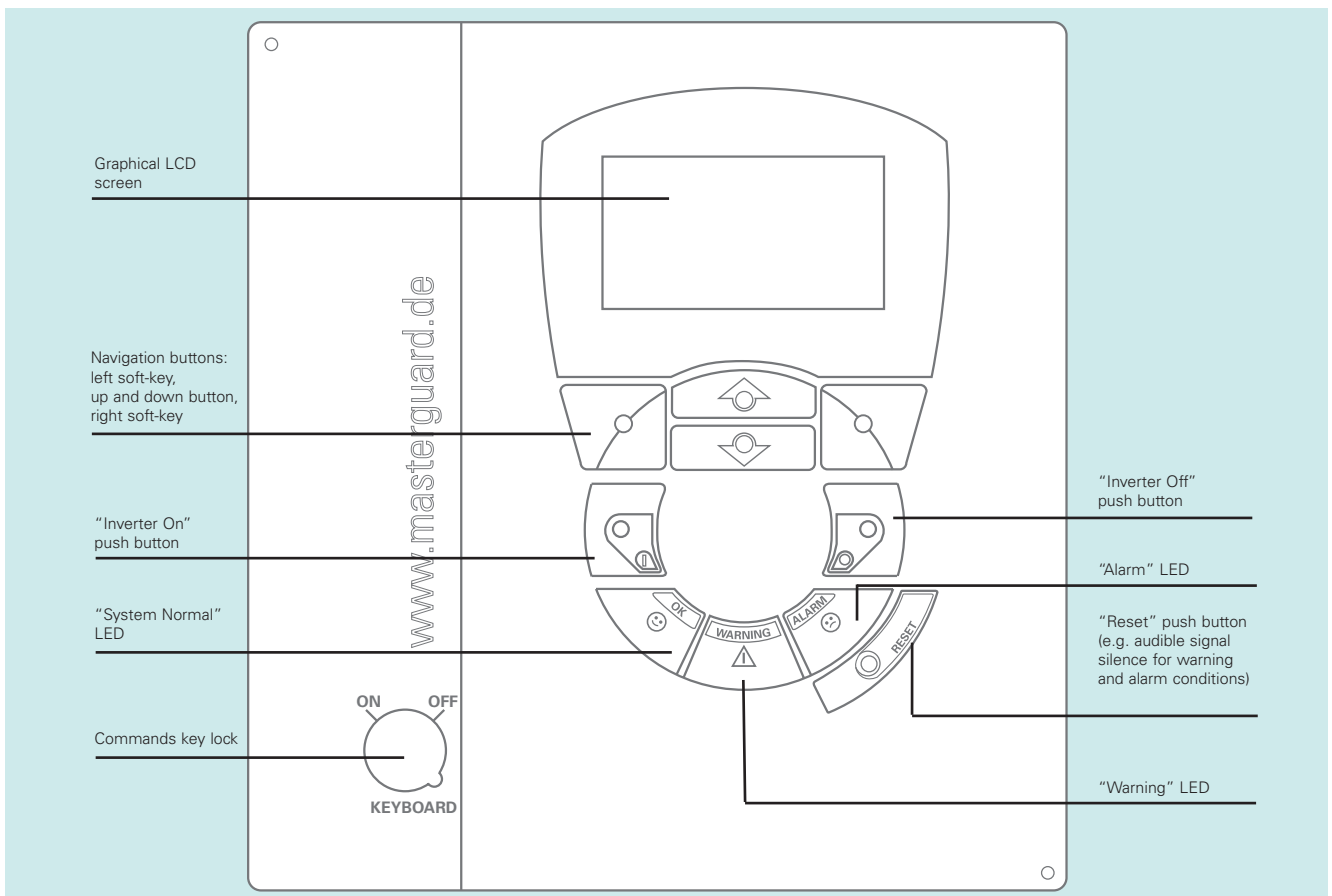
eight lines x 12 characters, displaying graphic diagrams and symbols) for complete UPS monitoring and control. Complete access to all LCD menus is possible through navigation push buttons located below the screen. This navigation group includes two buttons - "up" and "down" - for menu scrolling and two software-assigned push buttons: the function linked to these two buttons is displayed on the lower right and lower left corners of the LCD during navigation.

A single-line diagram of the UPS is continuously displayed on the default page (for reference see figure 1). The main functional blocks and power paths of the UPS are displayed using simple universal technical symbols, instantly communicating the overall status of the UPS. The same screen also permanently displays the output load percentage

measurement, using three histograms (one for each output phase). In the case of the UPS not in normal functioning mode, it is possible to access the "Warning and Alarm" summary page directly from the default page. Warnings and alarms shall be identified by text strings and codes. In battery operation, the display shall switch between warning code and estimated backup time in minutes.

After 30 seconds of inactivity (i.e. without buttons being pressed) the display reverts to the default page.

The text displayed by the LCD shall be available in English, Italian, French, German, Spanish Portuguese, Turkish and Chinese, selectable by the user.



8.3 Start and Stop Inverter push buttons

The Start and Stop push buttons are integrated into the mimic panel board, and have the following predefined functions:

	Start inverter operation
	Stop inverter operation

The control shall incorporate a safety feature to prevent inadvertent operation yet still allow for rapid shutdown in the event of an emergency. To stop the inverter the user must press and hold the Stop button for two seconds. An audio alarm shall be activated during this delay time.

8 Monitoring and control, Interfaces

8.4 Keyboard lock

The mimic panel shall be equipped with a front panel key that allows

users, once the lock is set in the Off position, to disable any command which may be entered through the mimic panel. In this state, if the

operator attempts to perform any of the following actions, a message reading "COMMANDS DISABLED" will appear on the LCD:

Start Inverter	Stop Inverter	Reset Fault
Set/reset Battery Test	Set/reset Autonomy Test	Set/reset Boost Charge
Test PFC	Set/reset Service Input	Set/reset I/O Configuration
LIFE Manual Call	Reset Delay Call	

8.5 General Status LED

Three LED indicators it shall render it possible to obtain a quick and general understanding of the status of the UPS, as described below.

OK LED (green)	Normal Operation When this light is on (not flashing), the system is running normally and neither warnings nor alarms are present. During mains failures (all other conditions at being nominal level), this LED will flash.
Warning LED (yellow)	Warning Condition(s) present This indication shall be activated by the presence of anomalous conditions, which could affect the nominal functioning of the UPS. These conditions are not originated with the UPS, but may be caused either by the surrounding environment or by the electrical installation (mains side and load side). It shall be possible to read the description of the active warning(s) by browsing the relevant LCD display menus.
Alarm LED (red)	Alarm Condition When this light is on, immediate attention should be given to the severity of the alarm, and service should be called promptly. It shall be possible to read the description of the active alarm(s) by browsing the relevant LCD display menus.

8.6 LCD display menus description

By using the appropriate push buttons it shall be possible to browse the following menus:

Rectifier/Charger and Battery

This menu shall display rectifier status, alarms, voltage, total DC current, battery current with polarity and battery temperature. When the inverter is supplied by the battery, the module shall display remaining autonomy time. A change in load shall cause the autonomy indicator to instantaneously display the new autonomy time.

Inverter

This menu shall display alarms, phase to neutral voltages, frequency measurements, inverter heatsink temperature and cooling air temperature.

Reserve Supply

This menu shall display alarms, phase to neutral voltages and frequency measurements.

Load/Static Switch

This menu shall display alarms, current per phase, frequency measurements, load percentage capacity per phase and the peak factor

l_{pk}/I_{rms} for each phase of the load current. It shall be possible to display the total time the load has been supplied by the inverter, and by reserve, the number of mains failures and the total duration of these failures.

Listed below are the most significant messages which may be displayed by the graphical LCD in the various menus. The exhaustive messages list and menus description is published in the User Manual.

8 Monitoring and control, Interfaces

8.6.1 Heading

Alarms/indications		
System In Alarm	E.P.O. Active	Auto Test
Life Service Mode	Do Not Insert Bat	Dial In Progress
Data Transf. Active	Slave Connection	Routine Call
Manual Call	Emergency Call	Life Buffer Full
Rescheduled Call	Eprom Checksum Fault	Eeprom Fault
Insuff.Ventilation	Ventilator Life End	Commissioning Mode
Cu Communication Lost	Parallel Reserve Fault	Pob Fault

8.6.2 Rectifier

Alarms/indications		
Alarm Active	E.P.O. Active	Charger Off
Hardware Test	Float Mode	Charge Mode
Equalise Mode	Recharge Inhibit	Battery Test
Rectifier Phase Up	Battery Autonomy Test	Mains Transf.Protect
Insulation Failure	Input Switch Open	Primary Supply Fail
Phase Sequence Error	Dc Sw Control Fault	User Dc Voltage Low
Dc Voltage Low	Dc Voltage High	Batt. Charge Inhibit
Testing Autonomy	Dc Feedback Fault	Dc Hw Control Fault
Dc Sw Control Fault Block	Rect. Overtemp	Rectifier in PFC Mode

8.6.3 Charger and Battery

Alarms/indications		
Alarm Active	E.P.O. Active	Battery Connected
Batt. Disconnected	Batt.Breaker Open	Battery Operation
Temperature Alarm	Battery Fault	Battery Fuse Blown
Insulation Failure	Shutdown Imminent	Battery Stand-By
		Battery SCR Fault
		Battery Almost Ended

8.6.4 Inverter

Alarms/indications		
Alarm Active	E.P.O. Active	Inverter Running
Inverter Fault	Inverter Turning On	Inverter Turning Off
Inverter Not Running	Remote Inv. Stopped	Overtemperature
Shutdown Imminent	Dc Voltage Low	Overload
Load Too High	Inverter Dc Voltage High	Extern Fast Turn Off
Inverter Start Failed	Heat Sink Overtemperature	Transformer Overtemperature
Desaturation	Inverter Voltage High	Inverter Voltage Low
Inverter Frequency Error	Inverter Short Circuit	Dc Component On Ph.1
Dc Component On Ph.2	Dc Component On Ph.3	I ¹ t Overload Ph.1
I ² t Overload Ph.2	I ² t Overload Ph.3	Max Output Power
Temp. Sensor Fault		

8 Monitoring and control, Interfaces

8.6.5 Reserve

Alarms/indications		
Alarm Active	E.P.O. Active	Reserve Valid
Reserve Not Valid	Reserve Not Avail	Res. Transf. Protect
Mains Synchro. Inhibit	Reserve Supply Warning	Backfeed Prot Active
Overload	Phase 1, 2, 3 Not Ok	Reserve Supply Fault
Reserve Hw Fault	Bypass Sens. Fault	

8.6.6 Load

Alarms/indications		
Alarm Active	E.P.O. Active	Load On Reserve
Load On Inverter	Load On Bypass	Load Not Supplied
Insulation Failure	System Output Sw Open	Sys.Bypass Sw Closed
Output Switch Open	Overload	Load Too High
Bypass Switch Closed		

8 Monitoring and control, Interfaces

8.7 Interfaces

8.7.1 Slot card bay (available from 60 to 500kVA)

Series S_{III} shall be equipped with two slot bays, available for communication card options. One of the slots shall be equipped with the LIFE.net slot modem, fitted as standard (user removable).

The other slot shall be available for connectivity options. Please refer to MASTERGUARD Connectivity Solutions for further details about the available slot expansion cards. If no cards are fitted into the slots, the DB9 ports described in sections 8.7.3 and 8.7.4 can be used for other connectivity applications.

8.7.2 Computer relay interface

Volt-free contacts shall be incorporated conforming to the requirements of IBM AS/400 and other computer types. This interface shall be via a 9-pin D socket wired as follows:

Pin	Signal	Explanation
1	BYPASS ACTIVE	Bypass mode: contact between pin 1 and pin 4 is closed
2	AC FAIL (NO)	Mains failure: contact between pin 2 and pin 4 is closed
3	AC FAIL (NC)	Mains failure: contact between pin 3 and pin 4 is open
4	SWITCH COM	Common connection for all floating contacts
5	LOW BATTERY	Just before end of discharge (in battery mode): contact between pin 5 and pin 4 is closed
6	UPS OFF	If "mains failure" warning is present, application of 12 V across pin 6 and pin 7 (0 V) shuts down the UPS
7	SIG GRD (0V)	Reference potential for UPS shutdown
8	SUMMARY ALARM	UPS fault, contact between pin 8 and pin 4 is closed
9	+12V	Internal 12 V, 50 mA voltage source for UPS shutdown (pin 6)

The Floating contacts shall be rated at 24V, 1A.

8.7.3 RS232C

Series S_{III} will be equipped with one D type connector with 9 pins for serial RS232C communication. The connector has the following pin functions:

Pin	Signal	Explanation
1	Earth	Shield
2	TxD	Send RS232
3	RxD	Receive RS232
4	Not used	
5	RS232 GND	Signal ground for receive and send
6	Not used	
7	RTS	Clear to send RS232
8	Not used	
9	Not used	

This RS232 port cannot be used simultaneously with the corresponding slot bay as described in section 8.7.1

8.7.4 Combination interface

Series S_{III} shall be fitted with a slot modem for LIFE.net connection as standard. If this slot modem is removed, this port may be used for other connectivity applications.

Pin	Signal	Explanation
1	Shield	Cable shield
2	SST2_TRS232	Send RS232 (Tx)
3	SST2_RRS232	Receive RS232 (Rx)
4	Not used	
5	Not used	
6	Not used	
7	M_BT	Signal ground
8	Not used	
9	Not Used	

8 Monitoring and control, Interfaces

8.8 Available signalisations and control signals

The UPS can handle up to 12 Input/Output control signals (8 inputs, 4 outputs) that can be programmed via

the display and/or PPVIS for a wide set of functions. Emergency Power Off (EPO) is programmed as standard: this command electronically shuts down the rectifier, the inverter and the bypass switch. Listed below are the

most significant functions; the exhaustive list is published in the User Manual:

Fan (On-Off) In Battery Compartment Battery	Fuse Monitor
Battery Compartment Overheated	Micro Switch UPS Doors
Backfeed Protection	Generator On
Hydrogen Present	Remote Inverter Stop
SBS Bypass Switch Closed	Insufficient Ventilation
SBS Output Switch Open	

8.9 LIFE.net

In order to increase the overall reliability of the system, Series S_{III} will be delivered with the LIFE.net communication kit, providing connection to MASTERGUARD's LIFE.net monitoring service. LIFE.net shall allow the remote monitoring of the UPS through telephone lines or GSM link in order to ensure the maximum reliability of the UPS throughout its operational life. The monitoring shall be a real 24-hour, 365 day service thanks to a unique feature that allows trained Service Engineers to remain in constant electronic contact with the service centre, and therefore the UPS. The UPS shall automatically dial-up the service centre at defined intervals to provide detailed information that shall be analysed in order to predict near term problems. In addition, it shall be possible to control the UPS remotely.

The communication of UPS data to the MASTERGUARD LIFE Command Centre shall take be transmitted via the integrated modem at the following intervals:

- ROUTINE: settable at intervals o between five minutes and two days (typically once a day)
- EMERGENCY: when a problems occurs or parameters are beyond tolerance limits
- MANUAL: following a requestfrom the command centre

During the call the command centreshall:

- Identify the UPS connected
- Request the data stored in the UPS memory since the last connection
- Request real-time information from the UPS (selectable)

The service centre shall analyse historical data and issue a regular detailed report to the customer informing him of the UPS operational condition and any critical states. The LIFE.net centre allows the possibility of activating the LIFE-SMS delivery system option, where the customer may receive SMS notification which will be activated in the event of one of the following:

- Mains power failure
- Mains power recovery
- Reserve line failure
- Load supplied by reserve.

9 Mechanical data

9.1 Enclosure

The UPS shall be housed in a space-saving modular enclosure with front doors and removable panels (protection as standard to IP 20). The enclosure shall be made of zintec coated sheet steel. The doors shall be lockable.

9.2 Ventilation

Forced redundant air cooling will ensure that all the components are operated within their specification. Airflow shall be controlled according to demand. The cooling air entry shall be in the base and the air exit at the top of the device.

The enclosure shall be installed with at least 400 mm of free space between the device and roof of the enclosure in order to allow cooling air to exit unhindered.

9.3 Cable entry

Cable entry shall be from the bottom or bottom-side of the cabinet. Top cable entry shall be available as an option.

9.4 Enclosure design

All enclosure surfaces of the enclosure shall be finished with an electrostatically applied epoxy coat. The coating shall have a thickness of at

least 60 microns. Standard colour of the enclosure shall be RAL 7035 (light grey).

9.5 Access to integrated subassemblies

All internal subassemblies shall be accessible for typical and most frequent maintenance from the front of the unit via hinged doors. Rear access shall not be required for installation or servicing. The UPS shall be forkliftable from the front after the removal of the bottom trim panels.

10 Environmental conditions

The UPS shall be capable of withstanding any combination of the environmental conditions listed below. It shall operate without mechanical or electrical damage or degradation of operating characteristics.

10.1 Ambient temperature

0° to 40°C
Maximum average daily temperature (24 hr) 35°C
Maximum temperature (8 hr) 40°C

10.2 Relative humidity

Up to 90% (non condensing) for temperature of 20°C.

10.3 Altitude

The maximum altitude without derating shall be 1000 metres above sea level or 1500 metres at 25°C. The derating shall be 1.2% for every 100 metres above 1000 metres.

MASTERGUARD Series S_{III}

UPS Systems from 60 to 800 kVA

11 Technical data (60 to 200 kVA)

UPS Unit	Rating	60	80	100	120	160	200
11.1 Rectifier input							
Nominal input voltage	(V)	400 3Ph (380 – 415 selectable)					
Tolerance on voltage assuming float @ 2.27V per cell	(%) ⁽¹⁾	±15					
Min. input voltage without battery discharge	(%) ⁽¹⁾	-25					
Nominal frequency	(Hz)	50/60 (selectable)					
Tolerance on frequency	(%)	±5					
Maximum input power @400V, Recharge Mode	(kVA)	85	111	139	168	222	278
Power factor @400V, PFC Mode	(±0,02)	>0.92					
Power factor @400V, Float Mode		>0.8					
Input current distortion @ maximum input power	(%)	<30					
Walk in/Soft start (programmable)	(seconds)	10 (1-90)					
Rectifier Hold-Off (programmable)	(seconds)	1 (1-180)					
Inrush current / I _{max} input ratio ⁽⁸⁾		<1					
Efficiency of rectifier in float ⁽²⁾ : Half load	%	98.9					
Full load	%	98.9					
11.2 Rectifier output							
Battery nominal voltage @ recommended number of cells, see 11.8	(V)	396					
Output voltage: Float for SLA @ 20°C	(V)	449					
Recharge	*(V)	475					
*Only for wet stationary lead batteries							
Battery float voltage temperature compensation (direct sensing)		-0.11% per °C					
Current ripple into battery for a 10 min autonomy as per VDE0510 ⁽³⁾		<0.05C10					
Voltage stability in steady state condition for 100% load variations or allowed input parameters variations	(%)	<1					
Voltage ripple in float condition	(%)	<2					
DC current supplied to inverter in float	(A)	115	153	190	229	303	379
Battery recharge current setting range	(A)	5-25	5-25	10-40	10-40	15-65	15-65
Maximum DC current	(A)	150	195	245	295	390	490
11.3 Inverter input							
Nominal voltage on float	(V)	449					
DC voltage range	(V)	326-540					
DC current when inverter at full load (0.8PF) and battery at end of discharge	(A)	158	210	260	315	417	521

11 Technical data (60 to 200 kVA)

UPS Unit	Rating	60	80	100	120	160	200
11.4 Inverter output							
Nominal apparent power @ PF 0.8 lagging 40°C	(kVA)	60	80	100	120	160	200
Nominal active power	(kW)	48	64	80	96	128	160
Nominal output current	(A)	87	116	145	174	232	290
Nominal apparent and active power @ PF >0.8, lagging or leading, 40°C		See note (7)					
Overload at nominal output voltage and 0.8 PF for 10 min	(%)	125					
Overload at nominal output voltage and 0.8 PF for 1 min	(%) ⁽⁶⁾	150					
Short circuit current capacity for 5 seconds (10ms)	(%)	150 (200)					
Nominal output voltage	(V)	400 (380/415 selectable) 3Ph + n					
Nominal frequency	(Hz)	50/60 (selectable)					
Voltage stability in steady state condition for input DC variations and 100% load variations	(%)	±1					
Voltage stability in dynamic condition for 100% nominal load step variations or DC input variations	(%)	Complies with IEC/EN 62040-3, Class 1					
Voltage stability in steady state for 100% unbalanced loads (0, 0, 100)	(%)	±3					
Output frequency stability							
In synchro with the mains	(%)	±0.75 (1.5, 2.5, 6 selectable)					
With internal quartz oscillator	(%)	±0.05					
Frequency slew rate	(Hz/sec)	<1					
Output voltage distortion with 100% linear load	(%)	<3					
Output voltage distortion @ reference non linear load as for IEC/EN 62040-3	(%)	<5					
Load crest factor without derating	(Ipk/Irms)	3:1					
Phase angle precision with balanced loads	(degrees)	<±1					
Phase angle precision with 100% unbalanced loads	(degrees)	<±2					
DC/AC efficiency ⁽²⁾ :							
Half load		92.0	92.5	93.0	93.0	93.5	93.5
Full load		93.0	93.0	93.5	93.5	94.0	94.0
Neutral conductor sizing		see Chapter 6.5					
Output power upgradability with temperature:							
At 25°C (%)		110					
At 30°C (%)		105					
At 40°C (%)		100					

MASTERGUARD Series S_{III}

UPS Systems from 60 to 800 kVA

11 Technical data (60 to 200 kVA)

UPS Unit			Rating	60	80	100	120	160	200
11.5 Reserve static switch									
Nominal voltage			(V)	400 (380/415 selectable) 3Ph + n					
Nominal frequency			(Hz)	50/60 (selectable)					
Frequency range			(%)	±0.75 (1.5, 2.5, 6.0 selectable)					
Voltage range			(%)	±10					
Maximum operating voltage			(V)	480/277					
Maximum overload capacity	For 10 minutes	(%)	125						
	For 1 minute	(%)	150						
	For 600 milliseconds	(%)	700						
	For 100 milliseconds	(%)	1000						
SCR	I ² t @ T _{vj} =130°C; 8.3-10ms (A²s)			80k	80k	80k	80k	320k	320k
	I _{TSM} @ T _{vj} =130°C; 10ms (A)			4k	4k	4k	4k	8k	8k
Fuse	Rating (Vac/A)			660/250	660/250	660/250	660/350	660/500	660/500
	Pre-arching I ² t (A²s)			4.4k	4.4k	4.4k	10.5k	23.8k	23.8k
	I ² t @ 400Vac (A²s)			31.5k	31.5k	31.5k	33.5k	105k	105k
Transfer time when in synchro (double conversion)									
Inverter to reserve			(ms)	<0.5					
Reserve to inverter			(ms)	<0.5					
Transfer time without synchro			(ms)	<20					
Retransfer delay			(sec)	<5					
11.6 System data									
Maximum input power @400V, Recharge Mode			(kVA)	85	111	139	168	222	278
Heat dissipation:	PFC Mode	(kW)	4.2	5.6	6.5	7.8	9.6	12.0	
	Rapid recharge	(kW)	4.4	5.8	6.8	8.1	10.0	12.6	
	Digital interactive	(kW)	1.5	2	2.5	3	4	5	
AC/AC efficiency ⁽²⁾ :	Half load double conv.	(%)	91.0	91.5	92.0	92.0	92.5	92.5	
	Full load double conv.	(%)	92.0	92.0	92.5	92.5	93.0	93.0	
	Digital Interactive	(%)	97	97	97	97	97	97	
Noise @ 1 metre as per ISO 3746			(dBA ± 2dBA)	62	62	62	64	65	65
Protection degree with open doors				IP20					
Mechanical dimensions:	Height	(mm)	1780						
	Width	(mm)	820	820	1020	1020	1420	1420	
	Depth	(mm) ⁽⁴⁾	858						
No of cabinet				1					
Colour	Frame	(RAL scale)	7035						
	Bottom panel	(RAL scale)	7035						
Weight			(kg)	660	660	720	875	1290	1290
Floor area			(m²)	0.68	0.68	0.85	0.85	1.18	1.18
Floor loading			(kg/m²)	980	980	850	1030	1095	1095
Cable entry				Bottom/Side					
Access				Front					
Cooling				Forced Ventilation					

11 Technical data (60 to 200 kVA)

UPS Unit	Rating	60	80	100	120	160	200
11.7 Environmental							
Temperature: Operating	(°C)	0-40					
Max average daily (24hrs)	(°C)	35					
Maximum (8hrs)	(°C)	40					
Maximum relative humidity @ 20°C (non condensing) (%)		up to 90					
Elevation without derating	(m)	1000					
(-1.2% Pn every 100m above 1000m)							
11.8 Battery							
Optimum battery temperature	(°C)	15-25					
DC power	(kW)	52	69	86	103	136	170
Recommended no. cells:	VRLA ⁽⁵⁾	198					
	WET	198					
	NiCd	310					
End of discharge voltage	(V)	326					
End of discharge current	(A)	158	210	262	315	417	521
Battery current setting range	(A)	5-25	5-25	10-40	10-40	15-65	15-65

(1) @ 192cells and nominal output power;

(2) for tolerance see IEC/EN 60146-1-1 or DIN VDE 0558;

(3) valid for 60-500kVA range only in PFC Mode;

(4) including front handle; without handle 830mm

(5) permitted number of cells = 192-204

(6) only with battery connected

(7) Units rated 60, 80 and 120kVA can supply loads with PF up to 0.8, leading or lagging, at full nominal output power. For the same ratings, loads with PF up to 0.9, leading or lagging, can be supplied at full nominal output power with limitation in the maximum value of battery recharge current. Please contact MASTERGUARD Technical Support for further details. For 100, 160 and 200 kVA, for loads with PF > 0.8 or leading please contact MASTERGUARD Technical Support.

(8) I_{max} input can be deduced from the maximum input power @ 400V, recharge mode

Note:

The data shown are typical and not definable in other ways; furthermore the data refer to 25°C ambient temperature and PF= 1 where not specified.

Not all the data shown apply simultaneously and may be changed without prior warning.

Data apply to the 6-pulse version, if not otherwise specified. For 12-pulse see chapter 13.

If the options described in chapter 13 are added, the data shown in table 11 may vary.

MASTERGUARD Series S_{III}

UPS Systems from 60 to 800 kVA

12 Technical data (250 to 800 kVA)

UPS Unit	Rating	250	300	400	500	600	800
12.1 Rectifier input							
Nominal input voltage	(V)	400 3Ph (380 – 415 selectable)					
Tolerance on voltage assuming float @ 2.27V per cell	(%) ⁽¹⁾	+15/-12					
Min. input voltage without battery discharge	(%) ⁽¹⁾	-21					
Nominal frequency	(Hz)	50/60 (selectable)					
Tolerance on frequency	(%)	±5					
Maximum input power @400V, Recharge Mode	(kVA)	351	421	562	702	842	1123
Power factor @400V, PFC Mode	(±0,02)	>0.9	>0.9	>0.9	>0.9	n.a.	n.a.
Power factor @400V, Float Mode		>0.8					
Input current distortion @ maximum input power	(%)	<5					
Walk in/Soft start (programmable)	(seconds)	10 (1-90)					
Rectifier Hold-Off (programmable)	(seconds)	1 (1-180)					
Inrush current / I _{max} input ratio ⁽⁸⁾		<4					
Efficiency of rectifier in float ⁽²⁾ :	Half load %	97.9	97.9	97.9	97.9	97.0	97.0
	Full load %	97.9	97.9	97.9	97.9	97.4	97.4
12.2 Rectifier output							
Battery nominal voltage @ recommended number of cells, see 12.8	(V)	480					
Output voltage: Float for SLA @ 20°C	(V)	545					
Recharge	(V)*	576					
*Only for wet stationary lead batteries							
Battery float voltage temperature compensation (direct sensing)		-0.11 % per °C					
Current ripple into battery for a 10 min autonomy as per VDE0510 ⁽³⁾		<0.05C10					
Voltage stability in steady state condition for 100% load variations or allowed input parameters variations (%)		<1					
Voltage ripple in float condition	(%)	<2					
DC current supplied to inverter in float	(A)	391	466	622	777	932	1243
Battery recharge current setting range	(A)	15-80	15-80	20-110	25-135	25-160	30-210
Maximum DC current	(A)	500	600	800	1000	1200	1600
12.3 Inverter input							
Nominal voltage on float	(V)	545					
DC voltage range	(V)	396-600					
DC current when inverter at full load (0.8PF) and battery at end of discharge	(A)	538	645	855	1069	1283	1710

12 Technical data (250 to 800 kVA)

UPS Unit	Rating	250	300	400	500	600	800
12.4 Inverter output							
Nominal apparent power @ PF 0.8, lagging 40°C	(kVA)	250	300	400	500	600	800
Nominal active power	(kW)	200	240	320	400	480	640
Nominal output current	(A)	362	435	580	725	870	1159
Nominal apparent and active power @ PF >0.8, lagging or leading, 40°C		See note (7)					
Overload at nominal output voltage and 0.8 PF for 10 min	(%)	125					
Overload at nominal output voltage and 0.8 PF for 1 min	(%) ⁽⁶⁾	150					
Short circuit current capacity for 5 seconds (10ms)	(%)	150 (200)					
Nominal output voltage	(V)	400 (380/415 selectable) 3Ph + n					
Nominal frequency	(Hz)	50/60 (selectable)					
Voltage stability in steady state condition for input DC variations and 100% load variations	(%)	±1					
Voltage stability in dynamic condition for 100% nominal load step variations or DC input variations	(%)	Complies with IEC/EN 62040-3, Class 1					
Voltage stability in steady state for 100% unbalanced loads (0, 0, 100)	(%)	±3					
Output frequency stability In synchro with the mains (%) With internal quartz oscillator (%)		±0.75 (1.5, 2.5, 6 selectable) ±0.05					
Frequency slew rate	(Hz/sec)	<1					
Output voltage distortion with 100% linear load	(%)	<3					
Output voltage distortion @ reference non linear load as for IEC/EN 62040-3	(%)	<5					
Load crest factor without derating	(I _{pk} /I _{rms})	3:1					
Phase angle precision with balanced loads	(degrees)	<±1					
Phase angle precision with 100% unbalanced loads	(degrees)	<±2					
DC/AC efficiency ⁽²⁾ :	Half load	93.5	94.0	94.0	94.0	94.0	94.0
	Full load	94.0	94.5	94.5	94.5	94.5	94.5
Neutral conductor sizing		see Chapter 6.5					
Output power upgradability with temperature:	At 25°C	110					
	At 30°C	105					
	At 40°C	100					

MASTERGUARD Series S_{III}

UPS Systems from 60 to 800 kVA

12 Technical data (250 to 800 kVA)

UPS Unit			Rating	250	300	400	500	600	800
12.5 Reserve static switch									
Nominal voltage			(V)	400 (380/415 selectable) 3Ph + n					
Nominal frequency			(Hz)	50/60 (selectable)					
Frequency range			(%)	±0.75 (1.5, 2.5, 6.0 selectable)					
Voltage range			(%)	±10					
Maximum operating voltage			(V)	480/277					
Maximum overload capacity			For 10 minutes	(%)	125				
			For 1 minute	(%)	150				
			For 600 milliseconds	(%)	700				
			For 100 milliseconds	(%)	1000				
SCR	I²t @ T _{vj} =130°C; 8.3-10ms (A²s) I _{TSM} @ T _{vj} =130°C; 10ms (A)		320k 8k	320k 8k	1125k 15k	1125k 15k	1125k 15k	4500k 30k	
Fuse	Rating (Vac/A) Pre-arching I²t (A²s) I²t @ 400Vac (A²s)		660/500 23.8k 105k	660/500 23.8k 105k	660/1000 142k 630k	660/1000 142k 630k	660/1000 142k 630k	660/1600 308k 1332k	
Transfer time when in synchro (double conversion):			Inverter to reserve	(ms)	<0.5 <0.5				
			Reserve to inverter	(ms)					
Transfer time without synchro			(ms)	<20					
Retransfer delay			(sec)	5					
12.6 System data									
Maximum input power @400V, Recharge Mode			(kVA)	356	421	562	702	842	1123
Heat dissipation:	PFC Mode	(kW)	17.4	19.5	25.9	32.4	n.a.		
	Float Mode	(kW)					41.7	55.7	
	Rapid recharge	(kW)	18.7	21.1	27.9	34.9	45.6	60.8	
	Digital interactive	(kW)	6.2	7.4	10	12.4	14.8	19.8	
AC/AC efficiency ⁽²⁾ :	Half load double conv.	(%)	91.5	92.0	92.0	92.0	91.2	91.2	
	Full load double conv.	(%)	92.0	92.5	92.5	92.5	92.0	92.0	
	Digital Interactive	(%)	97.0						
Noise @ 1 metre as per ISO 3746			(dBA ± 2dBA)	68	68	70	72	75	75
Protection degree with open doors				IP20					
Mechanical dimensions:	Height	(mm)	1780	1780	1780	1780	1780	1980	
	Width	(mm)	1620	1620	1620	2020	3860	3860	
	Depth	(mm) ⁽⁴⁾	858	858	858	858	1058	1058	
No. of cabinets				1	1	1	1	3	3
Colour	Frame	(RAL scale)	7035						
	Bottom panel	(RAL scale)	7035						
Weight			(kg)	1880	1880	2080	2580	3960	4820
Floor area			(m²)	1.35	1.35	1.35	1.68	3.98	3.98
Floor loading			(kg/m²)	1390	1390	1540	1535	1000	1210
Cable entry				Bottom/Side					
Access				Front					
Cooling				Forced Ventilation					

12 Technical data (250 to 800 kVA)

UPS Unit	Rating	250	300	400	500	600	800
12.7 Environmental							
Temperature: Operating	(°C)	0-40					
Max average daily (24hrs)	(°C)	35					
Maximum (8hrs)	(°C)	40					
Maximum relative humidity @ 20°C (non condensing) (%)		up to 90					
Elevation without derating (m) (-1.2% Pn every 100 m above 1000 m)		1000					
12.8 Battery							
Optimum battery temperature	(°C)	15-25					
DC power	(kW)	213	254	339	423	508	677
Recommended no. cells:	VRLA ⁽⁵⁾	240					
	WET	240					
	NiCd	375					
End of discharge voltage	(V)	396					
End of discharge current	(A)	538	645	855	1069	1283	1710
Battery current setting range	(A)	15-80	15-80	20-110	25-135	25-160	30-120

(1) @ 234 cells and nominal output power;

(2) for tolerance see IEC/EN 60146-1-1 or DIN VDE 0558;

(3) valid for 60-500kVA range only in PFC Mode;

(4) including front handle; without handle 830/1030 mm

(5) permitted number of cells = 234-246

(6) only with battery connected

(7) Units rated 250, 300, 400 and 500 kVA can supply loads with PF up to 0.8, leading or lagging, at full nominal output power. For the same ratings, loads with PF up to 0.9, leading or lagging, can be supplied at full nominal output power with limitation in the maximum value of battery recharge current. Please contact MASTERGUARD Technical Support for further details. For 800 kVA and 600 kVA for loads with PF > 0.8 or leading please contact MASTERGUARD Technical Support.

(8) I_{max} input can be deduced from the maximum input power @400V, recharge mode.

Note:

The data shown are typical and not definable in other ways; furthermore the data refer to 25°C ambient temperature and PF = 1 where not specified.

Not all the data shown apply simultaneously and may be changed without prior warning.

If the options described in chapter 13 are added, the data shown in table 12 may vary.

13 Options

Where options described in this chapter are added to the UPS, the data presented in the standard technical data tables may vary. Some options may not be available contemporarily on the same UPS.

13.1 Parallel configurations

See chapter 14.

13.2 Remote alarm unit

A remote alarm panel shall be available to display important individual messages from the UPS. Upon request, it shall be possible to display up to four UPS systems. The length of the connecting cable must not exceed 300 m.

13.3 External battery circuit breaker

This option shall include a fully rated circuit breaker and an additional auxiliary contact for monitoring its position. The circuit breaker shall be housed in a wall-mounted box and designed for battery systems which are mounted on racks. Furthermore, the circuit breaker shall serve as a safety element for the cross section of the power cable between UPS and the remotely placed battery system.

13.4 Backfeed protection (only upon request)

This option shall prevent any potential risk from electric shock on the UPS input AC terminals in the event of failure by the reserve static switch SCR. The option shall include a contact which activates an external isolating device such as an electromechanical relay. The external isolating device is not included in the option. Alternatively, it shall be possible to incorporate this device inside the UPS cabinet.

13.5 Additional RFI filters (only upon request)

Feed-through RFI filters shall be available housed in a matching cubicle. They allow a reduction of the conducted emissions up to the Class B of standard EN50091-2.

13.6 Battery leakage alarm

In conjunction with the rectifier isolation transformer option, the battery leakage alarm shall monitor the insulation resistance on the DC bus.

It shall also be possible to monitor the insulation resistance when the rectifier isolation is not present by taking the measurement when the input rectifier switch is open or the rectifier is switched off.

13.7 Battery Management Modules (only upon request)

With measuring modules connected to the battery blocks, enhanced battery management shall be possible offering the following features:

- Measurement of the condition of each individual battery block by means of separate battery measuring modules (BMM)
- Analysis of each battery block with measurement of the minimum and maximum voltage values.

13.8 Isolation transformer

This option shall be a double wound transformer housed in a matching cubicle. The transformer shall incorporate an electrostatic screen as standard. The option shall be used to isolate the rectifier/output/reserve from the mains AC input. Starting from 250 kVA cable entry shall be from the top; smaller versions shall have entry from the bottom. The transformer cabinets do not include switching devices. This option may significantly affect the reserve line inrush current, influencing the sizing of the upstream protection devices. For further information please contact the MASTERGUARD Technical Support; optional low inrush current isolation transformers may be provided on request.

13.9 Top cable entry

This option shall allow power cable entry from the top of the UPS.

13.10 Dust filters

This option shall improve the protection degree of the air entrance from IP20 to IP40 for specific applications such as a dusty environment. The filter shall be housed in the UPS cubicle (IP20).

13.11 Input harmonic filters for 6 pulse versions (only upon request)

The input current harmonic distortion

filter mounted within the 6 pulse rectifier UPS version (available only up to 200kVA) shall limit the THDi to less than 7%. The input power factor will depend on the output load fraction.

	6 pulse	6 pulse + 7% filter
5th harmonic	29 %	4 %
7th harmonic	5 %	3 %
11th harmonic	7 %	3 %
13th harmonic	1 %	1 %
17th harmonic	3 %	2 %
19th harmonic	1 %	1 %
Total THDi	30 %	7 %

13.12 12-pulse rectifier @ THDi < 5% (optional for 60 – 200kVA, standard from 250kVA).

This version shall consist of two 6 pulse rectifiers phase shifted by 30 degrees; with an additional inductive reactance on both rectifier branches. This shall attenuate the 5th, 7th, 17th and 19th harmonics in order to achieve a THDi of approximately 5%. The 12-pulse rectifier shall be housed within the UPS cubicle. When this option is fitted (for 60 – 200kVA range), the overall AC/AC efficiency shall be reduced by 2.5%, the generated acoustic noise increased by 1 dBA, the power factor in PFC Mode reduced to 0,90±0,02 and the input voltage tolerance is -11% @ 192 cells. The input inrush current shall be limited to $<4I_{max input}$.

	12 pulse + 5% filter
5th harmonic	1 %
7th harmonic	1 %
11th harmonic	4 %
13th harmonic	2 %
17th harmonic	-
19th harmonic	-
Total THDi	5 %

13.13 Multiple Bus Synchronization Module (MBSM)

The synchronisation kit shall be used to synchronise UPS systems in order to ensure perfect operation with CROSS system static switches. To achieve this, all UPS must be interconnected. The MBSM box allows for communication between up to six UPS. For more than six UPS cascaded MBSM boxes should be used.

13 Options

13.14 Empty battery cubicle

Matching empty battery cubicles shall be available including:

- Cubicle
- Disconnecting means
- Fuses
- Safety screen
- Connection terminals
- UPS/battery connection cables (for adjacent installations)

Three cubicle sizes shall be available:

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
Type A	820	858*	1780	220
Type B	1020	858*	1780	250
Type C	1020	1058*	1980	350

* including front handle; without handle 830/1030 mm

13.15 Empty options cubicle

A matching cubicle shall be available for customised applications such as:

- Input/Output voltage matching transformers
- Customised distribution boards
- Customised applications.

The options cubicle shall be available in four sizes:

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
Type A	820	858*	1780	180
Type B	1020	858*	1780	200
Type C	1420	858*	1780	250
Type D	1020	1058*	1980	300

* including front handle; without handle 830/1030 mm

13.16 Use as Frequency Converter

Series S_{III} may be programmed for use as a frequency converter (50Hz in – 60Hz out or 60Hz in – 50Hz out) for operations without a battery bank connected. In this operational mode, the data shown in tables 11 and 12 may vary (e.g. output overload capability). Please contact MASTERGUARD Technical Support for details.

13.17 Customer interface board

It shall be possible to increase the number of input/outputs described in section 8.8 by the adding of an additional board. These input/outputs can be used to monitor smoke, fire and water detectors, as specified by the user. Each board shall comprise:

- Four digital inputs (from voltage free contacts)
- Two outputs - voltage free contacts (1A 30V AC/DC)

13.18 Telephone switch for LIFE.net

The installation of the telephone switch for LIFE.net shall allow the user to use a telephone line normally reserved for other purposes (e.g. fax or telephone).

13.19 MopUPS Shutdown and monitoring software

The main function of MopUPS software shall be the safe shutdown of the operating system in the event of a power failure. Other functions include:

1. Automatic communications for events; e-mail, SMS, etc.
2. Saving to file of event log and status information
3. Viewing and monitoring of UPS in realtime
4. Programmed system shutdown
5. Remote monitoring of UPS connected to network server using Named Pipes or TCP/IP

13.20 ManageUPS adapter

This option shall include a complete package (including slot card adapter) to ensure monitoring and control of the networked UPS through TCP/IP protocol. The adapter permits:

- UPS monitoring from NMS via SNMP
- UPS monitoring from PC via a Web browser.
- Dispatch of e-mail messages on occurrence of events

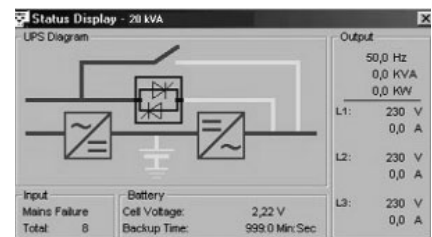
ManageUPS, in conjunction with MopUPS, shall also permit safe shutdown of the operating systems.

13.21 PPVIS surveys Monitoring Software

In addition to full monitoring capability, this powerful software connectivity tool allows complete access to the UPS configuration parameters. Therefore the user must attend a specialist training session with MASTERGUARD Service Engineers before being granted access to PPVis.

The survey images as displayed below supply the user with essential information on the connected UPS:

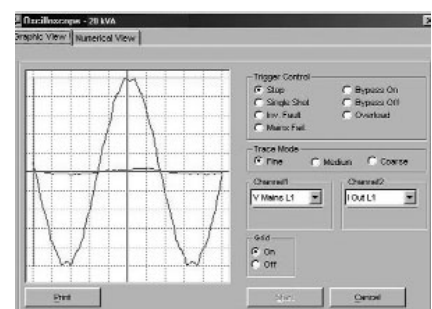
State indication - power flux survey



- Current state of components (UPS)
- Display of output voltage, UPS performance and load currents
- Number of power failures
- Battery cell voltage
- Available backup time

The oscilloscope - measuring of network or load conditions

- Dual-carrier measurement of the curves of input, output voltages or currents.
- Flexible definable trigger conditions capable of being coupled with the most varied events, such as when a mains failure occurs



13 Options

Battery display - Recognition of parasitic effects in the early stages (optional for single blocks)

- Measuring of the condition of each individual battery block shall be monitorable by means of separate battery measuring modules (BMM)
- By clicking of mouse the user may analyse each battery block with measurements of the minimum and maximum voltage values.

13.22 J-Bus protocol

An optional kit shall ensure the compatibility of Series S_{III} with the J-Bus protocol on RS485 port.

13.23 Profi Bus protocol

By installing a Profibus-DP connection Series S_{III} shall be linked up to higher level automatic systems. The Profibus –DP bus system enables very fast cyclical data exchange between higher-

level systems such as Simatic S5, S7, Symadyn D, PC/PG and field units. The following information shall be transmitted by Series S_{III}:

- Status of the unit
- Alarm information, information on faults
- Voltage levels at UPS output
- Control information

Compatibility Table

	LIFE.net	MopUPS	ManageUPS	PPVIS
LIFE.net		No	Yes	Yes
MopUPS	No		Yes	Yes*
ManageUPS	Yes	Yes		Yes
PPVIS	Yes	Yes*	Yes	

* use LIFE.net port for MopUPS

14 Parallel configurations

The Series S_{III} series of uninterruptible power supply systems shall be connectable in parallel for multi-module configurations between units of the same rating. The maximum number of UPS in parallel configuration shall be eight (seven for systems with a centralised static switch and for HFC systems). The parallel connection of UPS shall increase reliability and power.

Reliability.

If the installation requires more than one unit in redundant configuration the power of each UPS should not be lower than $P_{tot}/(N-1)$ where:

P_{tot} = Total load power
 N = Number of UPS units in parallel
 1 = Minimum coefficient of redundancy

Under normal operating conditions, the power delivered to the load shall be shared between the number of UPS units connected to the parallel bus. In case of overload the configuration may deliver $P_{ov} \times N$ without transferring the load onto the reserve, where:

P_{ov} = Max overload power of a single UPS
 N = Number of UPS units in parallel.

In the event of failure by one of the UPS units, the faulty unit shall be disconnected from the parallel bus and the load shall be supplied from the remaining units without any break in supply continuity.

Power.

It shall be possible to increase the power of the system using a non-redundant parallel configuration (redundancy coefficient = 0). In this case all connected UPS units shall deliver the rated power, and in the event of a unit failure or overload the system shall transfer the load to reserve.

A maximum of eight UPS may be connected in parallel. There shall be three alternative paralleling methods: modular parallel, centralised parallel with COC and high fault clearance (HFC) parallel mode.

Performance features.

The performance features of the parallel system are related to the UPS systems employed. The distribution of the load is divided equally between the individual UPS systems.

14 Parallel configurations

14.1 Modular

The UPS systems of the Series S_{III} shall be capable of operating in parallel modular configuration. For this purpose UPS systems of the same rating shall be connected in parallel to form multi-module configurations. The parallel connection of UPS shall either improve reliability, the total output power, or both. Provided Series S_{III} is supplied with the parallel kit option, up to eight equal UPS units can be operated in parallel for power upgrade or increase of redundancy. This option can also be added on at a later date. The option shall consist of one subassembly POB (Parallel Operation Board) and 25 pole, screened data lines to the neighbouring UPS modules. A multi-module system shall be controlled and monitored automatically by controlling the individual UPS systems. The reserve lines and inverters included in each UPS share the load. The load sharing among the UPS parallel system ("load on inverter" mode) shall be achieved with a tolerance of less than 5% at any system load fraction (0 - 100%).

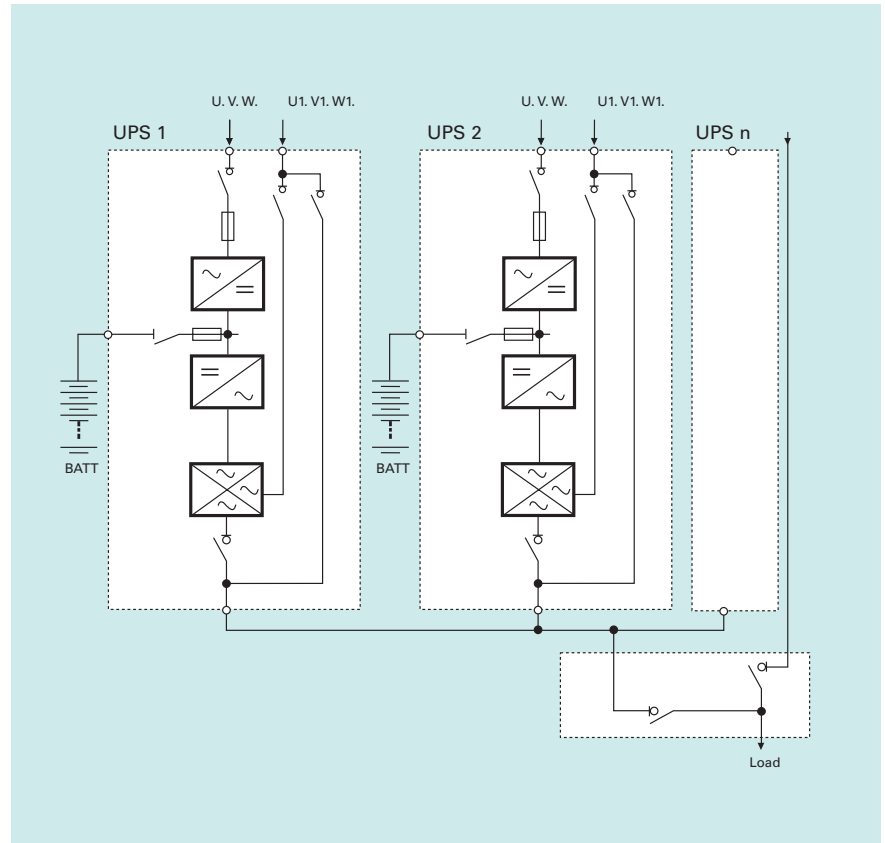


Figure 6. Modular parallel systems

14.1.1 System bypass switches

A system bypass switch shall be available as an option for the modular parallel configuration. For parallel systems including more than two UPS, a system bypass switch must be provided within the installation, including two power disconnect switches. The ratings available shall be:

	Height (mm)	Weight (mm)	Depth (mm)	Weight (kg)
400 A	1780	620	858*	300
800 A	1780	620	858*	400
1600 A	1780	1020	858*	500
2500 A	1780	1020	858*	600

* including front handle; without handle 830 mm

14.2 Centralised parallel with COC

The centralised paralleling architecture enables UPS with inhibited bypass to be connected in parallel. Hereby the reserve supply to the loads works with one central equipment (COC).

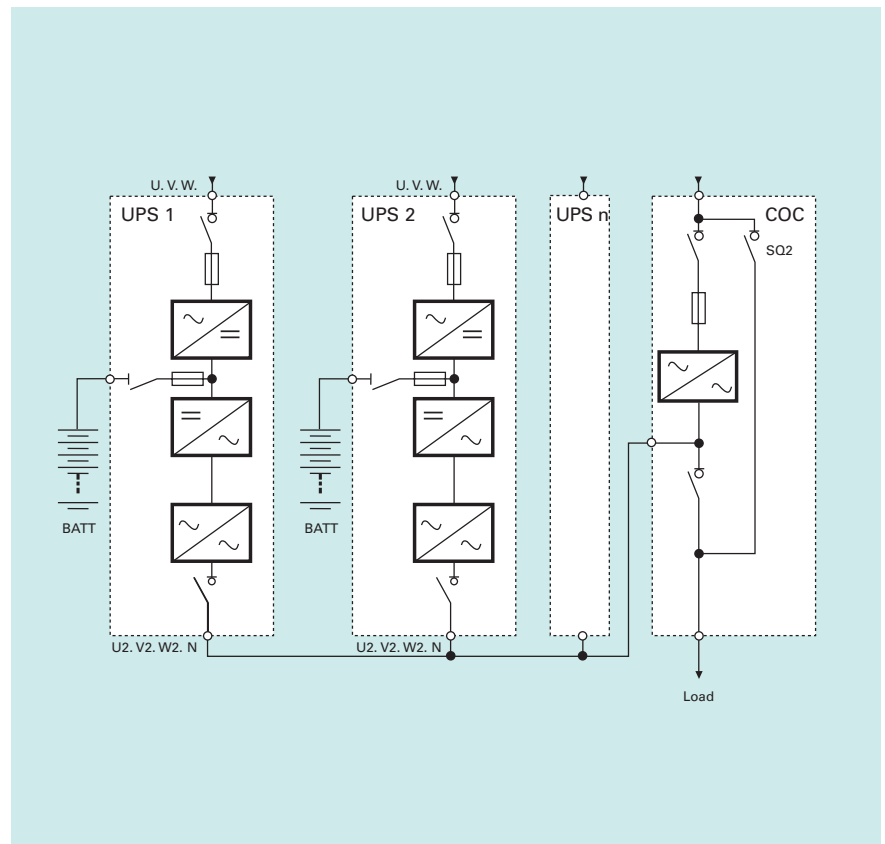


Figure 7. Centralised parallel systems with COC

14 Parallel configurations

Now a single UPS block consists of the following subassemblies:

- Rectifier
- Microprocessor, IGBT inverter
- Static switch, inline to the inverter
- Matching battery

The centralised switch COC (common output cubicle) see Figure 7. The COC includes:

- Electronic static switch and reserve supply
- Manual maintenance bypass switch (switches are not included in COC above 800A)

Centralised configuration offers maximum flexibility in positioning UPS blocks. Vector control ensures that different UPS blocks of a centralised parallel system can be placed at different localities. Power cables from the mains and to loads may be of different lengths.

It shall be possible to modify the parallel configuration of Series S_{III} from centralised to modular and vice versa (provided a COC is included in the system). This modification may be done at any time by simply disconnecting or connecting the COC to the parallel UPS.

14.3 High Fault Clearance Parallel Mode

It shall be possible to allow simultaneous operation of both the UPS reserve lines (within each UPS) and the common reserve line in the COC. Transfer to reserve will therefore involve the parallel operation of all the available reserve lines (both UPS and COC). As a result of such a paralleling of reserve static switches, the overall I_{st} capacity of the system shall be multiplied by four. The increased short circuit capacity of the high fault clearance parallel mode of operation will result in increased ability to clear faults downstream from the UPS and hence greater overall selectivity. HFC parallel mode shall only be feasible if all reserve lines originate from the same distribution. All modules within the HFC system (UPS and COC) will share the load equally.

14.4 COC monitoring and control

The COC shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, as well as take any appropriate action.

Mimic panel

The COC shall have a mimic panel with light emitting diodes (LEDs) to indicate the following conditions, see Figure 8:

UPS (A-H)	normal operation	green
Reserve supply	normal operation	green
Load static switch	normal operation	green
UPS (A-H)	alarm	green flashing
Reserve supply	alarm	green flashing
Load static switch	alarm	green flashing

Load/Bypass Switch

This module displays alarms, load voltage phase to neutral, current per phase, frequency measurements, percentage load capacity per phase and the peak factor I_{pk}/I_{rms} of each phase of the load current. It is possible to display the total time the load has been supplied by inverter, by reserve and time on parallel.

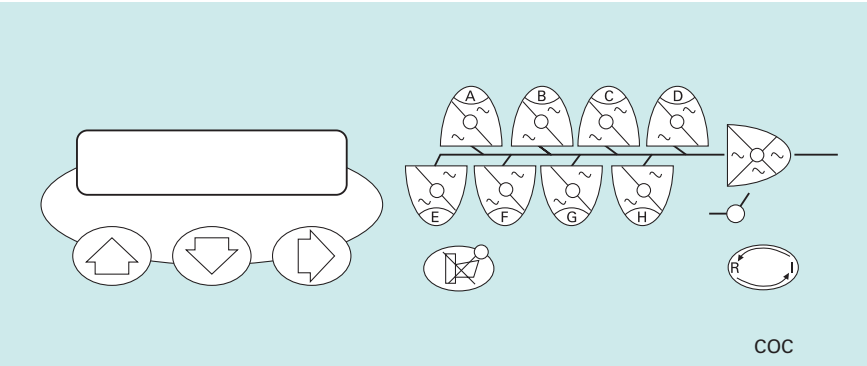


Figure 8.

Display

A 40 character illuminated LCD (two lines x 20 characters) shall be provided to enable the operating parameters of the UPS to be monitored. The LCD messages shall be accessed by push buttons. The text shall be available in English, Italian, French, German, Spanish and Portuguese, selectable by the user.

By using the appropriate user switches it shall be possible to display the following:

UPS

This module shall display alarms and status for the connected UPS in the parallel system.

Reserve Supply

This module shall display alarms, voltage phase to neutral and frequency measurements.

14 Parallel configurations

Signalling COC

Heading Alarms/indications EPO active	System normal	System test mode	System in alarm
LIFE.net (optional) Alarms/indications Service active	LIFE.net connection in progress	Active LIFE.net connection	
UPS Alarms/indications UPS (*) current limit	UPS (*) shutdown imminent	UPS (*) voltage and frequency irregular	
UPS (*) in alarm			
Reserve, Load Alarms/indications Backfeed active (option) Bypass switch closed Load not supplied Load on reserve UPS (*) in alarm Output switch open	Overload Reserve supply fault Reserve phase sequence error Reserve frequency fault Reserve voltage high Reserve voltage low	Static switch blocked on inverter Static switch blocked on reserve Static switch fault Reserve switch open Overtemperature Out of synchronisation	

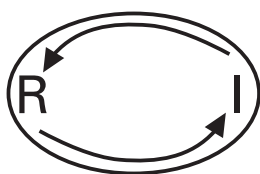
(*) Indicates the UPS involved.

Help procedure

The LCD display shall provide assisted start-up, shutdown, bypass and return to normal routines.

Control push button

In the right part of the display there shall be a further push button to control the COC. This push button shall enable the load to be transferred or re-transferred from the inverter to reserve or reserve to inverter depending on the original condition. The control shall incorporate a safety feature to prevent inadvertent operation.



MASTERGUARD Series S_{III}

UPS Systems from 60 to 800 kVA

14 Parallel configurations

14.5 COC Technical data			Rating	400A	800A	1600A	3200A	4000A
Electrical data								
Nominal current			(A)	400	800	1600	3200	4000
Power @ 380V			(kVA)	263	526	1052	2112	2640
Power @ 400V			(kVA)	277	554	1107	2208	2760
Power @ 415V			(kVA)	287	574	1149	2304	2880
Nominal voltage			(V)	400 (380/415 selectable)				
Nominal frequency			(Hz)	50/60 (selectable)				
Voltage range			(%)	± 10				
Frequency range			(%)	±0.75 (1.5, 2.5, 6 selectable)				
Maximum operating voltage			(V)	277 (480 PH-PH)				
Maximum overload capacity for 10 minutes for 1 minute for 600 milliseconds for 100 milliseconds			(%)	125	125	125	125	125
			(%)	150	150	150	150	150
			(%)	700	700	500	500	500
			(%)	1000	1000	700	700	700
SCR	I²t @ T _{vj} =130°C; 8.3-10ms (A²s) I _{TSM} @ T _{vj} =130°C; 10ms (A)			320k 8k	1125k 15k	Contact MASTERGUARD Technical Support		
Fuse	Rating (Vac/A) Pre-arching I²t (A²s) I²t @ 400Vac (A²s)			660/500 23.8k 175k	660/1000k 142k 630k			
Efficiency (when on reserve) AC/AC			(%)	99.5				
Transfer time when in synchro	Inverter to reserve	(ms)	<0.5					
	Reserve to inverter	(ms)						
Transfer time without synchro			(ms)	<20				
Retransfer delay			(s)	5				
System data								
Noise @ 1 metre as per ISO 3746			(dBA)	60	60	62	64	65
Protection degree with door open				IP20				
Mechanical dimensions	Height	(mm)	1780	1780	1780	1780	1980	
	Width	(mm)	1020	1020	820	1020	1020	
	Depth	(mm)	858*	858*	858*	858*	1058*	
*including front handle; without handle 830/1030 mm								
Switches:				included	included	not included	not included	not included
No. of cabinets				1				
Weight			(kg)	350	400	400	500	650
Floor area			(m²)	0.85	0.85	0.68	0.85	1.05
Floor loading			(kg/m²)	412	471	588	588	619
Cable entry				Top/Bottom/Side				
Access				Front				
Ventilation				Forced ventilation (active when SS is closed)				

14 Parallel configurations

14.5 COC Technical data		Rating	400A	800A	1600A	3200A	4000A
Environmental data							
Temperature	Operating temperature	(° C)	0-40				
	Maximum average daily (24 hrs)	(° C)	35				
	Maximum (8 hrs)	(° C)	40				
Maximum relative humidity @ 20°C (non condensing) (%)			up to 90				
Elevation without derating (m) (-1,2% Pnom every 100 m above 1000 m)			1000				

Planning and Installation

Installation site

Pay attention to the following conditions when selecting an installation site:

- This UPS must only be installed in closed operating areas. If the area contains, or if there is present in the area, any equipment containing in excess of 25 litres of inflammable fluids, refer to HD 384.4.42 S1 A2, chapter 42 (corresponds to DIN VDE 0100, Part 420), it must be ensured that burning fluids or their combustion products cannot spread through the building.
- The ambient temperature should be between 0°C and +40°C for UPS devices. For continuous operation at temperatures up to a maximum of +50°C, reduce the max. load by 12 % of the nominal load per 5°C.
- The ambient temperature should be between +15°C and +25°C for battery cabinets.
- Be sure to provide sufficient cooling of the installation room so that the ambient temperature remains within the stated limits. The heat emission ratings of the UPS are given in the Technical Data Tables. Be sure also to provide sufficient ventilation for the type of batteries used in the UPS.
- When operating the S_{III} UPS at altitudes above 1000m a.s.l., the load must be reduced accordingly (see User Handbook). If the ambient temperature remains less than +30°C, no load reduction is necessary for altitudes up to 2000 m.
- Ensure that the load carrying capacity of the floor is sufficient for the UPS and batteries. The floor must be even and level

Avoid harmful agents such as:

- vibration, dust, corrosive atmospheres and high humidity

Provide the following min. distances:

- minimum of 50 cm between the top of the cabinet and the roof
- no wall-distance if the cable is run through a double floor, otherwise the wall-distance must be at least equal to the bending radius of the cables in use. The distance between covering parts and floor is 150 mm.
- no limits on either side of device

Dimensions with packaging

Rating (kVA)	Width (mm)	Depth (mm)	Height (mm)*
60/80	1010	1010	2000
100/120	1210	1010	2000
160/200	1510	1010	2000
250/300/400	1810	1010	2000
500	1610	1010	2000
600 (I/P & INV)	1410	1210	2000
600 (O/P)	1610	1210	2000
800 (I/P & INV)	1410	1210	2200
800 (O/P)	1610	1210	2200

* Includes pallet.

- Use a suitable lifting truck to transport UPS and battery cabinets to the storage or installation site on the pallet the in original packaging (see).

Max. spacing for fork-lift bars (front)

	UPS (kVA)			
	60/80	100/120	160/200	250/300/400
max. (mm)	580	700	1100	1300
	UPS (kVA)		COC (A)	
	500	600/800	400/800	1600
max. (mm)	1100	900/1100	700	580

Installation data

Refer to the User Handbook and the Technical Data tables.

External dimensions - UPS

Rating (kVA)	Width (mm)	Depth (mm) ¹	+ Front panel ² (mm)	Height (mm)
60/80	820	858	820	1780
100/120	1020	858	820	1780
160/200	1420	858	820	710
250/300/400	1620	858	910	1780
500	2020	858	1010	1780
600	3860 ³	1058	710	1780
800	3860 ³	1058	710	1980

- ¹ Including handle and front panel
 - without handle -28mm
 - without panels -58mm

- ² Space required to open front panel - opening angle 60 to 500kVA: 120°
 - opening angle 600/800kVA: 90°

- ³ Combined width of three cabinets

External dimensions - COC

Rating (A)	Width (mm)	Depth (mm) ¹	+ Front panel ² (mm)	Height (mm)
400/800	1020	858	710	1780
1600	820	858	820	1780

- ¹ Including handle and front panel
 - without handle -28mm
 - without panels -58mm

- ² Space required to open front panel

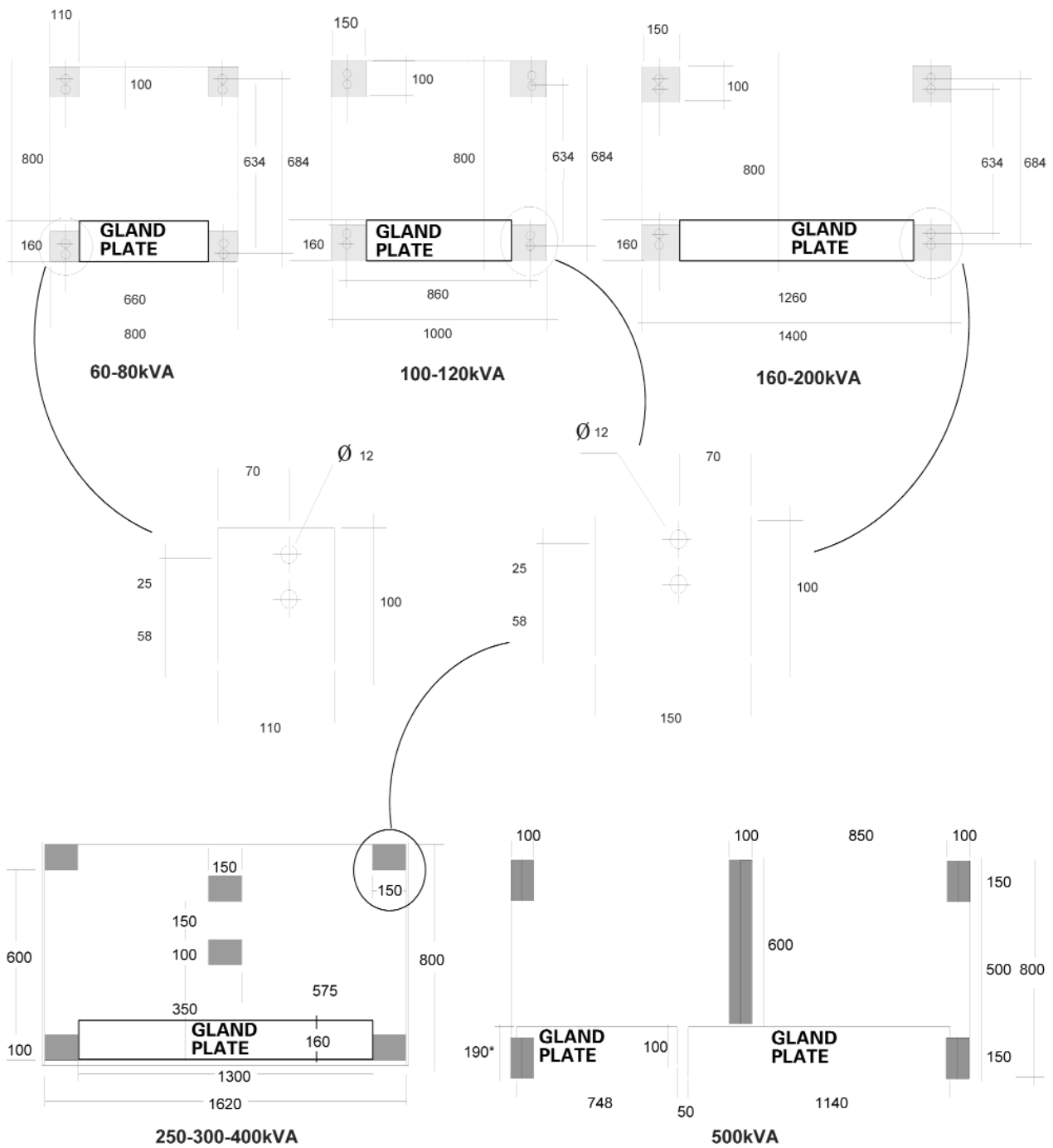
Secure devices against sideways tipping when moving them

If the device consists of three cabinets:

- Move cabinets to installation site.
- Push the cabinets together until no gap is visible between them.
- Connect the cabinets at the installation site with the screws included in the shipment. This has to be done in the upper and lower part inside the cabinet with a torque ratio of 13 Nm ±10 %.
- Connect the cabinets - See User Handbook for further details.

Planning and Installation

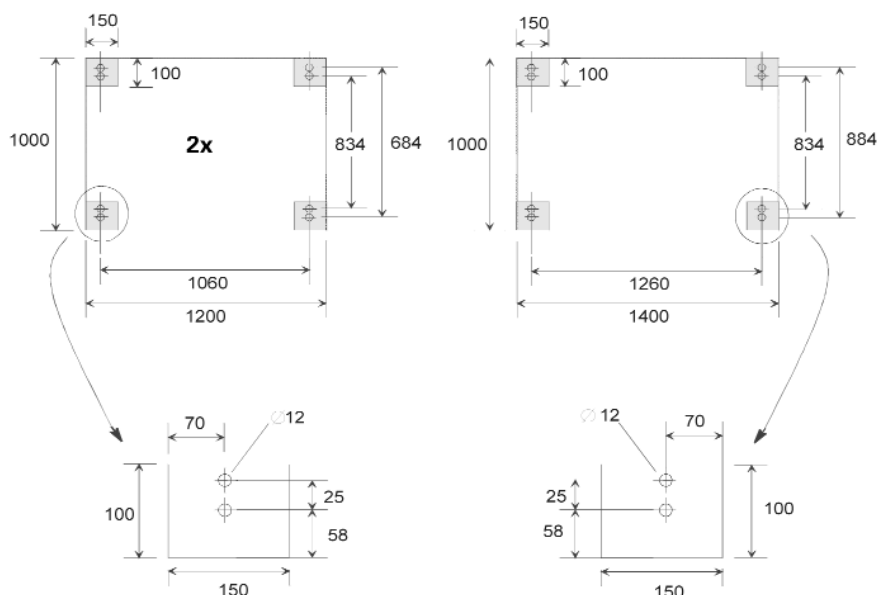
Footprint 60-500kVA



* Effective dimension = 157mm

Planning and Installation

Footprint 600-800kVA



POWER CONNECTIONS - UPS

UPS current ratings and cable cross sections

Description	UM	Rating (kVA)												
		60	80	100	120	160	200	250	300	400	500	600	800	
I _{in} max. @400V ⁽¹⁾	A	120	160	200	240	317	297	495	592	790	980	1154	1600	
Suggested wire size ⁽²⁾⁽³⁾	mm ²	60 (2x16)	70 (2x25)	95	120	2x70	2x95	2x120	2x180 (3x120)	4x120 (2x240)	5x120 (3x240)	3x240	4x240	
Wire socket screw size	mm	M8			M10			M12						
I _{nom} OP/Res @400V ⁽¹⁾⁽⁵⁾	A	87	116	145	174	232	290	360	435	580	725	870	1160	
Suggested wire size ⁽⁴⁾	mm ²	35 (2x10)	50 (2x16)	70 (2x25)	95 (2x35)	2x50	2x75	2x95	2x120 (3x70)	2x180 (3x120)	4x120 (2x240)	3x240		
Wire socket screw size	mm	M8			M10			M12						
I _{batt. in} (disch. @1.8V/cell)	A	145	193	240	289	382	478	493	591	788	985	1170	1570	
Suggested wire size	mm ²	70 (2x25)	95 (2x35)	120 (2x50)	2x70 (3x35)	3x50 (4x35)	2x120 (3x70)	3x120	3x120 (2x180)	4x120 (2x240)	5x120 (3x240)	3x240	4x240	
Wire socket screw size	mm	M10						M12						
Suggested earth wire size	mm ²	35		50	70	95	120		2x95	2x120 (240)	3x120 (2x180)	4x120 (2x240)		
Wire socket screw size	mm	M8			M10								M12	

¹ For nominal voltage of 380V, multiply current value by 1.05; for 415V, multiply by 0.95.

² With cable lug according to DIN46235.

³ When using the cable dimensions indicated in brackets a support rail shall be installed by the customer. The support rail supplied with the UPS must be removed.

⁴ For non-linear loads, the neutral cable dimension must be 1.6 times the recommended dimension.

⁵ The Reserve Input must be supplied by a three-phase plus neutral system. In the case of TN-S or TN-C systems, the neutral must be grounded in the upstream distribution system.

• Refer to the User Handbook for suggested IP/OP/RES protection devices.

Notes